Assessing the Impact of a High-Fidelity Simulated Interprofessional Clinical Experience on the Attitudes, Collaboration and Teamwork in Health Sciences Students: A Pilot Study

by

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Abstract

There is limited research that supports the use of high fidelity human patient simulation (HF-SICE) as a teaching learning approach to enhance interprofessional collaboration and teamwork in nursing, medicine and pharmacy students. The purpose of this quasi-experimental descriptive study was to assess the impact of participation in one HF-SICE on students' attitudes towards interprofessional education (IPE) and teamwork. Using the theory of situated cognition and the nursing education simulation framework to guide the study, twenty nursing students and ten medical students participated in the HF-SICE. Students reported a statistically significant improvement in their attitudes towards IPE ($t = -4.28$, $p = .000$) and teamwork ($t = -10.79$, $p = .000$). Students also reported they had a better understanding of the knowledge and the roles of different interprofessional team members after participation. All of the students were satisfied with the HF-SICE as a teaching approach and wanted to participate in more sessions. Teamwork and interprofessional collaboration are essential skills in today's complex healthcare arena; however, pre-licensure health sciences students have very little exposure to the roles and responsibilities of the team prior to graduation. This pilot study showed that participating in a HF-SICE can have a significantly positive impact on students' attitudes towards collaboration and teamwork. These findings give support for implementing HF-SICE as an effective teaching learning approach with nursing and medicine students. Further research is needed to assess the impact of HF-SICE on student teamwork in the clinical setting.

Keywords: Interprofessional collaboration, teamwork, high fidelity simulation

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Chapter 1

Nursing, medicine and pharmacy students often enter the workforce with little or no experience in collaborating with other members of the healthcare team (Robertson & Bandali, 2008). Yet, a team approach is required in today's healthcare system in order to maximize patient safety and minimize errors especially in the acute care setting. One healthcare professional alone cannot meet the healthcare needs of today's complex patients. Although interprofessional education programs can help to cultivate team performance, healthcare professionals have traditionally been educated in isolation with very little knowledge of the roles and responsibilities of the other members of a healthcare team (Reese, Jefferies, & Engum, 2010; Robertson et al., 2010; Schuetz, Mann, & Everett, 2010). This silo-like education system has created a significant barrier to effective interprofessional team performance in clinical practice (Bleakley, Boyden, Hobbs, Walsh, & Allard, 2006; Robertson & Bandali, 2008). Providing students in the different health professions with opportunities to learn with and about each other can facilitate teamwork and collaboration in the real-life healthcare setting, ultimately decreasing medical errors and improving patient outcomes (Schuetz, Mann, & Everett, 2010). Theoretically, if students from the different healthcare professions had more interprofessional learning opportunities, there would be a greater potential that they would perform more efficiently and effectively as a cohesive team upon graduation (Baldwin, 2007).

New graduates from the healthcare disciplines are often faced with the challenge of caring for complex patients with acute health issues. These difficult clinical situations require them to collaborate with other team members in applying their knowledge and skills to coordinate the care of the patient. Interprofessional collaboration is considered an important and requisite skill in caring for the seriously ill and this skill must be taught, supported and nurtured in undergraduate education (Robertson & Bandali, 2008). An innovative approach for educating students in the health science disciplines is the use of high-fidelity human patient simulation (HF-HPS) learning experiences. According to an inventory conducted by the Canadian Association of Schools of Nursing (CASN) on use of simulated learning in undergraduate education, high-fidelity simulation is rapidly being incorporated into the core curriculum of healthcare professionals (CASN, 2007). There is evidence to support that high-fidelity simulated learning experiences increase knowledge and confidence, promote critical thinking and help to enhance team performance (Reese, Jefferies, & Engum, 2010).

Simulation has been used as a teaching and learning strategy for many years in the military, aviation and nuclear industries to provide teamwork training in order to avoid and manage hazardous errors (Malac et al., 2007). The medical community has been using human patient simulation (HPS) since the early 1980's to provide students with opportunities to practice their requisite skills prior to performing them on patients in the actual clinical setting (Hunt, Shilkofski, Stavroudis, & Nelson, 2007). In recent years, high-fidelity simulation (HFS) has been introduced into the nursing curricula to teach nursing students their required skill set, to build confidence and to facilitate critical thinking (Reese et al., 2010). Most recently simulation is being introduced into pharmacy curricula to teach communication skills (Mesquita et al., 2009) and promote the safe and knowledgeable use of medications (Thompson & Bonnell, 2008). Given these three health professional education programs are using intraprofessional simulation education, albeit to different extents, the next logical step is to progress to interprofessional simulation education. Bringing these pre-licensure health sciences students together in a simulated clinical learning environment would help to facilitate and nurture the teamwork skills that are required and expected of these students upon graduation and entry into practice. If simulated interprofessional clinical experiences (SICEs) were integrated into the curriculum of nursing, medicine and pharmacy education programs, there is great potential to improve confidence, knowledge, critical thinking, collaboration and teamwork in the practice setting. This could ultimately lead to improved patient care and safety outcomes, which is the raison d'être for teamwork and collaboration in the health science professions (Robertson & Bandali, 2008). There exists a vast body of knowledge supporting high- fidelity clinical simulation and an equivalent quantity of research supporting interprofessional education, yet there is a shortage of literature linking the two in undergraduate health sciences education programs (Aliner, Harwood, Harwood, Montague, & Ruparelia, 2014; Robertson & Bandali, 2008; Smithburger, Kane-Gill, Kloet, Lohr, & Seybert, 2013).

Purpose

The purpose of this pilot study was to evaluate high–fidelity human patient simulation (HF-HPS) as a viable and innovative tool, to facilitate teamwork and collaboration in pre-licensure students in the health sciences disciplines. Undergraduate health sciences students were provided with the opportunity to take part in a high-fidelity simulated interprofessional clinical experience (HF-SICE), so that the researcher could evaluate whether this experience had a positive impact on their attitudes towards teamwork and interprofessional education. If participating in a HF-SICE was found to help promote teamwork and collaboration in this pilot sample, this would support further research and the possibility of incorporating HF-SICEs in the curriculum of undergraduate health sciences students’ educational programs in the future.

Research Questions

The following research questions were addressed:

1. Does participation in a HF-SICE promote positive change in attitudes towards interprofessional teams?

2. Does participation in a HF-SICE promote positive change in attitudes toward interprofessional education?

3. Does participation in a High-Fidelity Simulated Interprofessional Clinical Experience (HF-SICE) facilitate collaboration and teamwork in pre-licensure health sciences students?

4. Will health sciences students report high levels of satisfaction with their HF-SICE?

Definitions

Debriefing: occurs immediately following the high-fidelity simulated interprofessional clinical experience (HF-SICE) and is a process where participants in the HF-SICE reflect on the simulation experience to examine what was learned.

Fidelity: the extent to which the mannequin mimics reality. Human patient simulators (HPS) are available in three levels of fidelity (high, moderate and low). A definition, by way of example, for low-fidelity simulation is the use of a simple intravenous arm simulator, where a student is able to develop one particular skill set such as starting an intravenous line or practice giving injections. Low- fidelity could also be round table discussion or case studies. A medium-fidelity simulator attempts to incorporate a higher degree of reality into the model by bringing into play such humanistic characteristics as lung or heart sounds, albeit without actual chest wall movement. Finally, high-fidelity human patient simulators are far more complex, and can respond appropriately to clinical interventions by healthcare providers.

High Fidelity Simulation (HFS): simulations that use high-fidelity mannequins.

High Fidelity Simulated Interprofessional Clinical Experience (HF-SICE): a simulated clinical experience where students from more than one healthcare profession come together to learn and practice their skills in a very real, life-like environment with a high fidelity mannequin.

Human Patient Simulator (HPS): for the purpose of this study a human patient simulator is a life-like high-fidelity mannequin that mimics a real person.

Interprofessional: when two or more health disciplines collaborate together for the purpose of coordinating care (Curran et al., 2009).

*Interprofessional education: "*occurs when students from two or more professions learn about, from, and with each other to enable effective collaboration and improve health." (WHO, 2010)

Intraprofessional: an activity or learning experience that occurs within one profession.

Simulations: educational technique that allows situations or activities that mimic real life.

Team: "a group of two or more individuals who perform some work related task, interact with one another dynamically, have a shared past, have a foreseeable shared future and share a common fate" (Beaubien & Baker, 2004, p. i51).

Teamwork: the behaviors that facilitate effective team collaboration and performance.

Conceptual Framework

The conceptualization of this study was based on the theory of situated cognition as first described by Lave and Wenger (2009). Situated cognition theory's central tenant is that learning best occurs in the context of real life situations. HPS using high-fidelity, life-like mannequins to simulate real life clinical situations is becoming increasing popular in providing the context in which to optimize experiential learning. Situated cognition theory posits that learning and the setting in which the learning occurs are intricately coupled and co-dependent. High-fidelity simulators provide the safest and surest way to achieve in-situ knowledge transfer by engaging the participants in authentic activities that meld mind, body, and action (Paige & Daley, 2009). Students can experience firsthand, high risk and deteriorating clinical situations where they can learn from their mistakes without causing any undue harm to the patient (Garbee, Paige, Barrier, Kozmenko, Kozmenko, Zamjahn, 2013). This embraces Lave and Wenger's (2009) conviction regarding the rich significance of the learning that occurs within the human experience.

The situated cognition theory, as it applies to HPS has four basic tenants (Page & Daley, 2009):

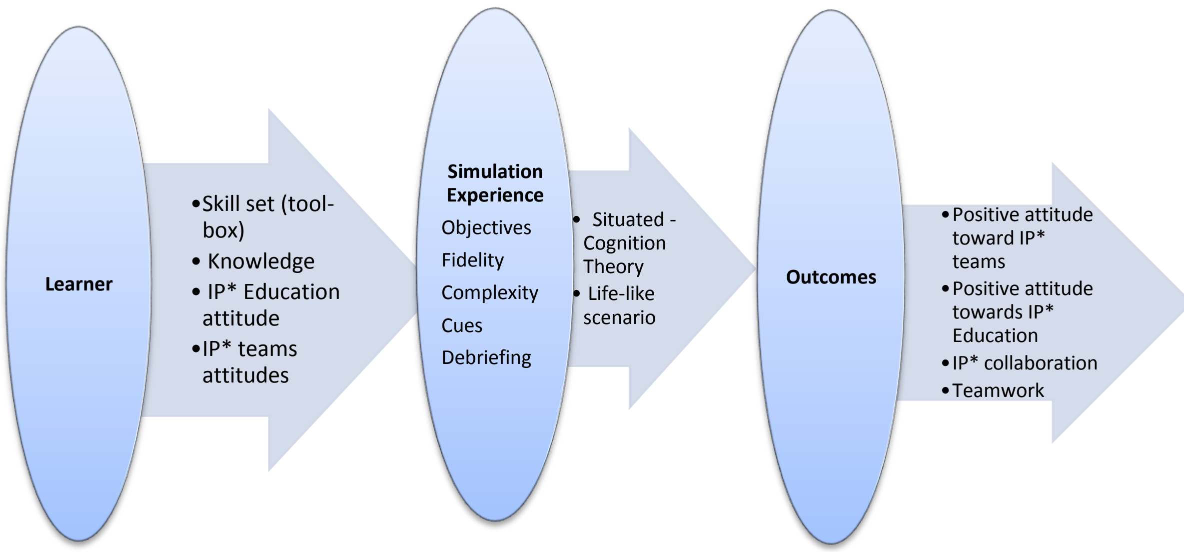
1. Knowledge must be transferred in an authentic environment.
2. Participants must interact with the simulated patient in a real life manner.
3. Participants utilize their pre-existing knowledge, called their “tool-box”.
4. Participants must be encultured into the healthcare environment where the participants are able to interpret the patient’s needs and act appropriately as if it were a real life situation. Participants understand that their decisions pertaining to the patient’s care has the potential to harm or benefit the patient.

This pilot study incorporated the framework of situated cognition and its tenants as outlined above to guide the learning experience. For learning to occur during a HF-SICE, situated cognition proposes that knowledge is being accumulated through all the senses. This is accomplished as students are fully immersed in the situation, interacting with the simulated patients, and collaborating with the team member to make care decisions. Students view and interpret the readings on the cardiac monitor, obtain the patient's vital signs, initiate intravenous fluid administration, give appropriate medications and so forth. These activities engage the senses and help to facilitate immersion into the clinical simulation by the students. The "patient" is lying on an actual hospital bed, with the usual hospital furniture at the bedside. There is actual medical equipment attached to the patient, as well as authentic medical supplies all around. The learning experience is situated in a very real, life-like clinical situation where knowledge can be applied and skills can be practiced, learned and honed. The team is able to make care decisions for the patient as the experience evolves, and these decisions are reflected in the simulated patient's condition in real time. His condition will either improve or deteriorate, totally dependent on the team's decisions and interventions. A simulated learning experience allows the learner to witness the outcome of the care provided and to make further decisions regarding the care of the simulated patient. The simulated clinical situation provided by HFS has the potential to promote learning, and enhance team performance and collaboration, and ideally improve patient outcomes (Lunberg, 2008). In essence, it is the point where theory and practice merge.

Simulation Design Framework

Simulations for the purpose of teaching and learning can be complex and challenging to design in order to optimize the experience. Therefore a framework was designed to guide this study using the theory of situated cognition by Lave and Wenger (2009) and the work by Jefferies (2007) as outlined below (see Figure 1).

Figure 1. Conceptual Framework



*Interprofessional

Successful learning in a simulated clinical experience requires appropriate simulation design and organization (Jefferies, 2005). The simulation design for this study was based on the Nursing Education Simulation Framework (NESF) developed by Jefferies (2005). No other appropriate design framework was identified from the medical or pharmacy health sciences literature. In her work, Jefferies discusses the importance of creating simulations that include individuals from a variety of healthcare disciplines and in fact she has used her design framework in interprofessional simulations (Jefferies, 2007). She believes that interprofessional simulations enable students to achieve a better understanding of the roles of each profession; they help students to develop a mutual respect for one another and allow students to learn together as teams, caring for the critically ill in stressful situations (Jefferies, 2007). Consequently, the NESF was used to guide the development on the HF-SICE for this pilot study.

The five characteristics of the design framework are: objectives, fidelity (realism), complexity, cues, and debriefing (Jefferies, 2005). The objectives guide the learning and are essential for the simulation experience. The objectives must be clearly written in order to direct the student's learning and must reflect the learner's level of knowledge and experience. Each objective must clearly state the expected outcomes, specify the learner's behaviour and include enough detail to allow full participation by the learner.

The fidelity of the simulation experience refers to the extent to which the simulated experience mimics real life. As previously mentioned there are three levels of fidelity: low, moderate, and high. The high-fidelity simulator used for this study was capable of making verbal responses, as well as responding physiologically to the interventions of the interprofessional team. The simulation room was set up as a hospital room and students had access to a "real" chart and all the equipment necessary to manage the simulated patient's condition. This added to the realism of the experience and facilitates enculturation of the participants (Jefferies, 2007).

The complexity of the simulation scenario developed for this study reflected the level of knowledge and skill at which the pre-licensure health sciences students were expected to practice. As Jefferies (2007) notes, the complexity needs to be challenging yet attainable.

Cues are given at standardized times throughout each of the scenarios if required, to help the students progress through the simulation. The cues provide information to the learners such as a phone call from the lab with a critical value or the patient verbalizing a specific complaint. These cues aid in the students progression through the simulation, while stimulating thought and group problem solving (Jefferies, 2007). The timing and extent of the cues were determined in consultation with expert faculty from the health sciences disciplines involved.

Debriefing is a necessary and valuable process in the simulation exercise and it should occur immediately following the simulation scenario (Jefferies, 2007). The debriefing allows students and faculty to examine what happened and what was learned. It allows for reflective thinking so that the participant can assess their own actions as well as the actions of the team. The role that each team member assumed can be examined as well as the communication styles used can be evaluated. The session was led by a faculty member who engaged the students to reflect upon their learning, and the experience as it unfolded. As well the discussion also explored the knowledge and skills that may have been obtained by the participants. It is essential that the debriefing occur in a non-threatening environment where students can openly discuss their feelings without the threat of “finger pointing” or academic prejudice.

Summary

The integration of HF-HPS into interprofessional education is a fairly new and innovative concept. Bringing undergraduate healthcare disciplines together to learn with and about each other has potential to circumvent the negative attitudes that may develop when healthcare students are educated in isolation from each other. The ultimate goal of interprofessional education is to improve teamwork, communication and collaboration amongst the healthcare disciplines, skills that have been deemed essential in providing safe patient care. The purpose of this study is to explore HF-SICEs as an interprofessional teaching and learning strategy to support positive attitudes toward interprofessional education and interprofessional teams and allow undergraduate healthcare students to practice their teamwork and communication skills in a safe realistic environment. Ideally, these HF-SICEs will help prepare students to practice collaboratively in today's healthcare setting.

Chapter 2: Literature Review

This chapter will review the literature from 2006 to 2014, as it applies to the use of high-fidelity simulation as an educational tool in the pre-licensure health sciences disciplines of medicine, nursing and pharmacy. The evidence exploring the most common outcome measures of high-fidelity simulation in undergraduate education including knowledge, confidence, communication, collaboration and critical thinking will be reviewed. Examination of the literature regarding the use and benefits of high-fidelity simulation in interprofessional education will also be included.

Human Patient Simulation

Human patient simulation (HPS) is a method of teaching clinical skills by recreating a real life clinical setting in an interactive safe environment (Fritz, Gray, & Flanagan, 2008; Mauro, 2009). High-fidelity human patient simulation (HF-HPS) represents the latest state-of-the-art technology for education in the health sciences disciplines (Bremner, Addell, Bennett, & Vangeest, 2006). Depending on the scenario these simulators, more specifically high fidelity simulators, portray realistic “humanlike” responses such as moaning in pain, slurred speech, and decreased levels of consciousness. These high-end human patient simulators can be programmed to replicate a wide variety of disease processes and clinical symptoms. Additionally, high-fidelity patient simulators may be programmed to develop physical symptoms in response to treatments or medications given, thereby helping students immediately observe potential physiological effects of a medication error without actually causing harm to the patient (Olejniczak, Schmidt, & Brown, 2010; Prion, 2008; Robertson & Bandali, 2008). In the actual clinical setting, medication errors can result in serious harm or even death, if healthcare professionals do not respond appropriately. For that reason, high-fidelity simulated interprofessional clinical experiences (HF-SICEs) can help students practice working together to respond appropriately in such complex situations without any risk of harm to the patient. Therefore, HF-HPS has the potential to improve learners' knowledge, self-confidence, clinical judgment and overall team performance (Aliner, Hunt, Gordon, & Harwood, 2006; Dillon, Noble, & Kaplan, 2009; Garbee et al., 2013). The number, variety, and complexity of these simulated clinical learning experiences through HF-HPS are vast and limited only by the imagination of simulation educators.

High Fidelity Human Patient Simulation in Medical Education

Simulation is not new to the discipline of medicine. In fact simulation has been used since the 1960's in the healthcare setting to teach practicing physicians and residents their requisite clinical skills (Harlow & Sportsman, 2007; Hunt et al., 2007; Nehring & Lashley, 2004). In the 1960's the company Laerdal, based in Norway, developed a full size mannequin on which to practice mouth-to-mouth ventilation in order to teach cardio-pulmonary resuscitation to physicians. This early simulator became known as Resusci-Anne and rapidly spread around the world for utilization in teaching medical personnel how to respond in the case of a cardiac arrest and potentially save lives (Grenvik & Schaefer, 2004).

High-fidelity simulation has the potential to benefit the many students in medicine who have reported that they are not adequately prepared to enter the clinical setting upon graduation. Students often feel there is a disconnect between the classroom and the clinical environment; consequently simulation has been proposed as a learning modality to help bridge this theory-practice gap (Okuda et al., 2009). HF-HPS in medical education has been used for the past three decades by medical educators to enhance knowledge, and to provide a safe practice environment for undergraduate medical students to practice their clinical skills and gain clinical competence and confidence (Issenberg et al., 2005).

While simulation is frequently used with pre-licensure medical students, interns, residents, as well as practicing physicians, this review will only examine the use of high-fidelity simulation with pre-licensure medical students that focus on more recent studies exploring confidence building, crisis management in various clinical situations and team collaboration as the potential benefits of HF-HPS. Studies of high-fidelity simulation used to teach basic sciences and human physiology to medical students will not be included in the review.

High fidelity human patient simulation and obstetrical care. One particular area where hands-on training may surpass text books and lectures is the speciality area of obstetrics. Four studies were found that investigated HF-HPS in the teaching of obstetrics and vaginal deliveries to pre-licensure medical students; one used an experimental design, one was a quasi-experimental design and two were surveys.

Dayal, Fisher, Magrane, Goffman, Bernstein, and Katz (2009) used a randomized trial to assess whether medical student's performance, knowledge and confidence with vaginal deliveries was higher with simulation training plus traditional education versus traditional education alone. They also explored the relationship between simulation training and students' participation in subsequent live deliveries during their obstetrical rotation. Third year medical students (n = 33) enrolled in their obstetrical clinical rotation were randomized into the simulation training group (n = 18) or the traditional teaching control group (n = 15). Both groups received the traditional lecture on delivery manoeuvres and a demonstration of a vaginal delivery with a low-fidelity pelvic skeleton. In addition, the simulation group participated in a 60-minute lecture and demonstration of a vaginal delivery using a high-fidelity simulator and practiced deliveries for one to two hours using the HF-HPS. They received corrections and feedback on their performance from faculty.

Three days following their sessions both groups were evaluated on their skill for vaginal delivery using the high-fidelity simulator by an assessor blinded to randomization using a competency-based obstetrics skill assessment tool developed by the researcher. All students were assessed again during the fifth week of their obstetrical clinical rotation. Students also completed an author-developed confidence survey on how self-confident they felt in conducting a vaginal delivery.

Results of this study demonstrated that the overall delivery skill assessment scores were statistically significantly higher for the simulation group in the initial assessment and at week 5 ($p < .001$) in the simulated environment. While there were no differences in confidence between the two groups at baseline, the confidence scores in the ability to perform vaginal delivery was statistically significantly higher for the simulation group at week 5. Most importantly, the simulation group participated in more live vaginal deliveries in their obstetrical clinical rotation than the control group (9.8 ± 3.7 versus 6.2 ± 2.8, $p < .005$). In summary students who had more hands on practice in the HF-HPS reported that they felt more clinically competent and confident in their obstetrical skills and were more likely to take advantage of opportunities to participate in vaginal deliveries in the clinical setting.

Clinical competence and confidence was also explored in medical students entering the obstetrical clinical area for their first time. Scholz, Mann, Kopp, Kainer, and Fischer (2012) used a randomized trial to assess self confidence in medical student’s ability to perform vaginal deliveries using a HF-HPS versus a low-fidelity, static model. A convenience sample of medical students ($n = 46$) was randomized into either the high-fidelity simulator group ($n = 23$) or a low-fidelity, static pelvic model group (n = 23). Both groups received the traditional lecture on labor and delivery followed by demonstration and practice on either a HF-HPS or low-fidelity static model. Students completed a researcher developed self-assessment questionnaire before and after the obstetrical course. Students' skills were also evaluated on three performance tests which focused on requisite obstetrical skills. Results from the self-assessment questionnaire indicated the HF-HPS group significantly improved in their self-assessments ($p = .031$), and felt more confident in delivering a baby ($p = .004$). The performance test results indicated that the high-fidelity students performed significantly better with regards to vaginal examination skills ($p = .001$) and interpretation of fetal heart tracings ($p = .000$). Interestingly, when the students were asked to integrate their findings to make further obstetrical decisions there were no differences between the groups. To explain this result, the authors argued that all the students were limited in their decision making by their amount of obstetrical knowledge regardless of the fidelity on which they were trained.

Deering, Hodor, Wylen, Poggi, Nielsen, and Satin (2006) surveyed 78 third year medical students following their obstetrical rotations. Three groups of students (n = 60) received the traditional and faculty directed instruction while a fourth group (n = 18) received traditional instruction as well as HF-HPS instruction. Following their clinical rotations all students completed a self-assessment survey developed by the researcher which assessed their comfort with basic obstetrical procedures. Survey results demonstrated that the simulator group felt statistically significantly more comfortable in performing five of seven common obstetrical procedures ($p < .001$) and reported a better understanding of two of four indications for initiating obstetrical procedures ($p < .03$) as compared to the group who received traditional training. The authors reported that based on the results of this study all medical students at their hospital now receive simulator training during their obstetrical rotation and that HF-HPS has great potential in the area of obstetrical training.

Jude, Gilbert, and Magrane (2006) surveyed a convenience sample of third year medical students ($n = 33$) following their obstetrical educational session. Students were assigned into the simulation training group ($n = 17$) who practiced vaginal deliveries on a high-fidelity obstetrical simulator or to the non-simulation group ($n = 16$) who received no further formal instruction. All students completed a researcher developed questionnaire assessing their level of confidence in performing the various skills of a vaginal delivery independently or with minimal supervision. Statistically significant results were reported by the students in the simulator group for eight of eleven skills required for performing a vaginal delivery ($p < .05$) compared to the non-simulator group.

Crisis management and emergency care. Another common use of HF-HPS in medical simulations is in the area of crisis resource management (CRM). Upon graduation physicians are expected to be competent in managing emergency situations yet they may not have had any previous experience in doing so. Realistically it is quite difficult to teach the management of life threatening situations using the traditional didactic method (Yang et al., 2009). Consequently there have been several studies examining HF-HPS as a feasible modality to teach medical students how to perform in crisis situations to better prepare them for managing clinical emergencies when they graduate. Six recent studies were found that investigated the ability of HF-HPS to improve the confidence levels of medical students in managing emergency situations; five used experimental designs and one used a quasi-experimental design.

McCoy et al. (2010) used a prospective, randomized, non-blinded crossover design to compare simulation-based training with the traditional lecture style to teach fourth year medical students (n = 28) how to manage a critically ill patient experiencing a myocardial infarct (MI) and a patient experiencing anaphylaxis. All students were given an orientation to the high-fidelity simulator, and then randomized into the simulation group (n = 16) or the lecture group (n = 12). On day 1, the simulation group used HF-HPS to assess and make care decisions for a critically ill patient experiencing an MI; the lecture group received a traditional lecture on managing the same type of patient. All students were then evaluated using a researcher developed skills test checklist which evaluated their ability to assess and manage an MI patient in an HF-HPS scenario. Day 2 the students' switched groups and the lecture group received instruction on the management of a patient experiencing anaphylaxis using HF-HPS and the simulation group from day 1 received the same instruction via a didactic lecture. Again students were evaluated using a researcher developed checklist on managing a patient experiencing anaphylaxis using HF-HPS. Results showed that 27 of the 28 participants performed a better assessment when trained with the HF-HPS ($p < .0001$) regardless of the specific clinical scenario. The mean overall score was 93% for the simulation group compared to 73% for the lecture group. The authors concluded that while HF-HPS appears to be superior to the traditional lecture they were unable to extrapolate whether simulation-based training is transferable to the clinical environment.

Similar to the McCoy et al. (2010) study, Eyck, Tews, and Ballester (2009) in a randomized cross-over trial evaluated test performance and satisfaction with a simulation-based curriculum of fourth year medical students (n = 91). Students were randomized into either the HF-HPS group A (n = 46) or the discussion group B (n = 45) during their emergency medicine course. During the first week of their emergency medicine rotation all students received an orientation to the HF-HPS. Group A students covered the topics of chest pain and altered mental status using HF-HPS, whereas group B were taught using the traditional format. For the second set of topics of airway and dyspnea the groups switched teaching methods where group A covered the topics via discussion and group B received HF-HPS based instruction. The final multiple choice exam and researcher developed satisfaction survey were completed at the end of their emergency medicine rotation. Results indicated a small improvement in learning of the simulation group (89.8%) as compared to the discussion group (86.4%) on the final exam. Significantly fewer questions were missed for the material covered in the HF-HPS format as compared to topics covered by the discussion format ($p = .006$). The mean scores on the satisfaction surveys revealed that students found the simulation to be more stressful ($M = 4.1$; 95% CI 3.9 - 4.3), more stimulating ($M = 4.7$; 95% CI 4.5 - 4.8), provided a safer learning environment ($M = 4.6$; 95% CI 4.5 - 4.7), more enjoyable ($M = 4.5$; 95% CI 4.3 - 4.6), a better overall learning experience ($M = 4.4$; 95% CI 4.2 - 4.5), and more realistic ($M = 4.6$; CI 95% 4.4 - 4.7) compared to that of the discussion groups. The authors concluded that HF-HPS learning improves performance on a written exam and that students preferred simulation based learning.

Lo and colleagues (2011) in a randomized controlled trial evaluated the retention of knowledge from the Advanced Cardiac Life Support (ACLS) course in medical students who were trained using HF-HPS ($n = 45$) to those students ($n = 41$) who were trained using the traditional teaching method. Students were evaluated on two simulated cardiac arrest scenarios immediately following their respective training method as well as at 1-year post training. Findings showed that the HF- HPS group scored higher than the traditional teaching group, 83% versus 70% ($p < .0001$). However at the 1-year follow-up there were no statistically significant differences in the two group scores. Satisfaction with the experience was significantly higher with the HF-HPS group ($P < .0001$); however confidence in ACLS knowledge was not different between the groups at baseline or at the 1-year mark. The authors concluded that research should focus on ways to improve long term retention of knowledge which include courses that incorporate HF-HPS training.

Similarly in a Malaysian study Yang and colleagues (2010) used an experimental design to compare HF-HPS with traditional didactic teaching as a means to enhance medical students' ($n = 77$) understanding of crisis management and resuscitation. Students were randomized into the simulation group ($n = 37$) who received training on the management of cardiac arrhythmias using HF-HPS and the traditional teaching group ($n = 40$). The HF-HPS students scored statistically significantly higher on their written test with an average score of 70.22% as compared to the traditional didactic lecture group who received an average score of 65.98% ($p < .05$).

Shukla et al. (2007) explored the use of HF-HPS to teach lifesaving techniques as well as improve confidence in third year medical students ($n = 240$). This was a pretest-posttest study without a control group and took place over a two year period. Students rotated through a number of skill stations that covered material pertinent for the management of a trauma patient followed by the use of HF-HPS to manage a trauma patient. The HF-HPS scenario was followed immediately by a faculty-led debriefing session. A researcher developed simulation survey evaluated student confidence in caring for a trauma patient using seven items and acceptance of simulation training. The results showed a statistically significant increase ($p < .05$) from pretest to posttest for all ten of the questions. Results for the overall course evaluation were 97.55% in favor of HF-HPS activities. The authors concluded that the use of simulation enhanced student confidence in performing lifesaving skills.

While the majority of evidence appears to support HF-HPS as a means to increase medical student knowledge and self confidence, this is not a universal finding. In a randomized trial conducted in Michigan, Schwartz, Fernandez, Kouyoumjian, Jones, and Compton (2007) randomly assigned fourth year medical students during their emergency medicine clerkship rotation to either a case-based learning group (n = 52) or a HF-HPS group (n = 50); both groups received instruction on the management of a patient with chest pain. In contrast to the previous studies there were no differences in performance between the two groups on their objective structured clinical examination (OSCE) (p = .164) as assessed by a trained evaluator blinded to intervention groups. Students were evaluated on their assessment and treatment of a standardized patient using 43-point checklist. A strength of this study is that sessions were video recorded and subsequently scored by physicians who were also blinded to the students method of instruction. The authors concluded that there was no advantage to simulation as compared to case-based learning in training students to manage a patient with chest pain.

Communication and team collaboration. Poor communication skills, as well as a breakdown in communication have been deemed the root cause of 60-70% of adverse events in the healthcare setting (Marshall, Harrison, & Flanagan, 2010). As a result simulation has been proposed as a means to help improve the breakdown in communication amongst healthcare professionals and some medical schools are beginning to utilize HF-HPS to teach communication and collaboration techniques to students. Only two studies were found evaluating the use HF-HPS to teach communication skills to medical students.

Morgan, Cleave-Higg, Desousa, and Lam-Mcculloch (2006) at the University of Toronto, Canada, explored the use of HF-HPS as a means to allow medical students the opportunity to apply their classroom theoretical knowledge in the practice setting by using the “life-like”, safe environment of the HF-HPS. Their study, carried out over a two-year period, involved final year medical students (n = 299) who were assigned to teams of two or three (n = 103 teams). During a one day session students completed a multiple choice pharmacology pretest at baseline prior to participating in four HF-HPS sessions involving caring for a patient with cardiac arrhythmias. Following the four scenarios students were given feedback by faculty using the videotaped scenarios. Students were then given an educational package to review on the management of cardiac arrhythmias. Afterwards the student teams participated in the same four scenarios and completed the pharmacology posttest. Student team performance was assessed using a performance checklist and a five-point global rating scale developed by the researcher.

Results showed a statistically significant improvement on the written pharmacology posttest ($p < .0001$). There was also a significant improvements in the team performance checklist and global rating scores of team performance between the pretest and posttest scenarios ($p = < .0001$). This suggests that working together repeatedly fosters better team performance and collaboration. As well HF-HPS allows faculty the opportunity to assess and evaluate communication and team performance skills of pre-licensure students and gives students the opportunity to practice and receive feedback in order to hone these requisite skills.

In an Australian study, Marshall, Harrison, and Flanagan (2010) conducted a study utilizing simulation as a means to assess communication skills of medical students. Senior medical students (n = 177) were randomized into either the intervention group (n = 85) who received formal education training on communication techniques or the control group (n = 85) who did not receive any communication training. The two groups were subdivided into teams (n = 17) of four to six students. All teams participated in a HF-HPS scenario which required them to make a phone call seeking guidance from a senior clinician who was not blinded to the intervention. The simulations were video recorded and reviewed by two blinded observers for content and clarity. The communication content mean score was statistically significant higher for the group who had received communication training as compared to the group who did not receive any training ($p < .001$) and the clarity of the communication was also higher for the intervention group ($p < .001$). This supports the use of HF-HPS as an educational tool for faculty to assess and evaluate a student's communication skills prior to interacting with real patients in the clinical setting. From this study the authors concluded that fully immersing students in realistic HF-HPS provides a controllable environment in which to observe and assess communication techniques of students.

Summary. Almost all the literature reviewed supports the use of HF-HPS to enhance the knowledge and skill of undergraduate medical students and supports its use as a tool for assessment and evaluation of students by faculty. Findings also suggest that students are overwhelmingly satisfied with this method of learning and often feel more confident following their HF-HPS experiences. However, it is not conclusive that this increase in confidence equates to clinical competence or if this confidence is maintained over time. The designs of the studies reviewed included eight experimental designs, two quasi-experimental designs as well as two post intervention surveys. The limitations of the studies reviewed include small sample sizes without a control group and only one study followed up with the participants at the one year mark to ascertain if the participant's confidence was maintained. Measurement tools used are often researcher developed with little information on the psychometric characteristics such as reliability and validity. It is widely acknowledged that further research with more rigorous guidelines with larger sample sizes using standardized tools with strong psychometrics is required. However, despite these limitations according to Okuda et al. (2009) simulation-based training is here to stay. In fact, many training programs and academic institutions are experiencing a paradigm shift as a result of simulated learning (Clark, Fisher Arafeh & Druzen, 2010). This is open for debate as the evidence to date does not appear to be strong enough to support this shift. Simulation is not able to replace the traditional learning modality but evidence supports it as a valuable adjunct and the students readily embrace the experience.

High–Fidelity Human Patient Simulation in Nursing Education

While HF-HPS has been established in medical education since the 1960's it has only entered the nursing field in the last two of decades. More attention and subsequently more research studies are being carried out to establish the usefulness of HF-HPS in the realm of undergraduate nursing education. According to the Canadian Association of Schools of Nursing (CASN) HFS as a teaching strategy is rapidly being implemented in the curriculum of undergraduate, graduate, and continuing education for most health professions in Canada including nursing (CASN, 2007). In the United States a national survey of undergraduate nursing programs revealed that 87 % of the responders used high- or medium-fidelity simulation in their programs (Hayden, 2010).

One of the main reasons for the vigorous pursuit of simulated learning is that it has the potential to improve what is considered one of the most important concerns in healthcare today, patient safety (Henneman, Cunningham, Roche, & Curnin, 2007). HF-HPS allows nursing students the opportunity to experience an array of high-risk situations without risk to patient safety. This safe environment allows students to make errors and omissions without causing harm to actual patients (Broussard, 2008; Gore, Hunt, & Raines, 2008). Additionally, simulation helps the student to more realistically appreciate the effects of their own, and fellow students, unsafe nursing practice. Being able to witness the end result of adverse events such as medication errors, allows the student to gain insight into the error, learn from it, and ideally prevent it from happening in the actual clinical setting (Broussard, 2008;Thompson & Bonnell, 2008).

Knowledge and skill acquisition. Knowledge gain and skill acquisition is one of the pioneer uses of HF-HPS in healthcare education. Several studies have evaluated the use of HF-HPS as a viable modality to teach pre-licensure nursing students their practical nursing skills prior to entering the actual clinical setting. Nursing faculty members are able to assess and evaluate a student's knowledge and skill demonstration in a safe "life like" environment. Four recent studies were found exploring the use of HF-HPS to improve student knowledge and skill acquisition; three used a quasi-experimental design and one used an experimental crossover design.

In a pretest-postest design Hoffman, O'Donnell, and Kim (2007) examined HF-HPS as an adjunct to the traditional clinical experience as a means to improve the knowledge of senior level nursing students ($n = 29$). All students completed the Basic Knowledge Assessment Tool-6 (BKAT-6) on the first day of class to establish their baseline scores. This assessment tool has established internal consistency reliability and validity. All students were enrolled in a senior level medical-surgical nursing course, divided into groups of seven or eight and assigned to a general medical-surgical floor under the direct supervision of a nursing faculty member. Midpoint in the course the students left the clinical area and finished the remainder of their clinical experience using HF-HPS. All students then completed the BKAT-6 again. Paired t-test showed a statistically significant improvement on the BKAT-6 ($p < .05$) at the end of their combined clinical and simulation experience. According to the authors this study supports the use of HF-HPS as an adjunct to the clinical setting to enhance students' knowledge.

A small pilot study by Kardong-Edgren, Anderson, and Michaels (2007) used a pretest-posttest design with a convenience sample of pre-licensure nursing students (n = 14) to ascertain if HF-HPS improved test scores on knowledge of congestive heart failure (CHF). The students were randomly assigned into one of three groups: group 1 was lecture only, group 2 was lecture and low-fidelity, and group 3 was lecture and high-fidelity. Following randomization all students completed a researcher developed pretest questionnaire on CHF and then received a 15-minute lecture on CHF. Following this, group 2 had a 15-minute low-fidelity simulation experience and group 3 had a HF-HPS experience. All three groups then completed the same knowledge posttest questionnaire. Results indicated that there were no statistically significant differences between the pretest and posttest scores for any of three groups. However there was a trend to improvement in scores of the low and high fidelity groups as compared to the lecture only group. The authors suggest that the reason for the lack of significant differences in the test scores may be due to the small sample size.

While HF-HPS may enhance knowledge, more research is needed to establish if this knowledge gain is actually transferred to the clinical setting. Consequently, Kirkman (2013) in her study examined whether there was a transfer of learning from the classroom to the clinical setting. In a time series design study, a convenience sample of nursing students (n = 42) was observed and rated on their ability to perform a respiratory assessment. The students were rated by a faculty member using a performance rating tool developed to reflect the Objective Structure Clinical Exam (OSCE). Students were observed and rated at time 1, which was in the traditional clinical setting prior to their respiratory lecture, at time 2 in the traditional clinical setting following their respiratory assessment lecture and at time 3 in the traditional clinical setting following their asthma HF-HPS experience. The study found statistically significant improvement in OSCE scores from time 1 to time 2 and from time 2 to time 3 with the greatest improvement following HFS clinical experience (time 3). The authors concluded that transfer of learning took place after both the didactic lecture and after HFS and therefore a combination of these two teaching modalities as well as traditional clinical experience is recommended.

Similarly Shinnick, Woo, and Evangelista (2012) used a repeated-measures crossover experimental design to evaluate HF-HPS as a predicator of improved learning outcomes compared to the traditional method of teaching. A convenience sample of pre-licensure nursing students (n = 162) from three different schools of nursing were randomized into the experimental group (n = 90) and the control crossover group (n = 72). All students from the three schools had received the traditional didactic lecture on heart failure and the related clinical experience specific to their program. At pretest all students completed the study questionnaires which included Kolb’s Learning Style Inventory, the California Critical Thinking Skills Test (CCTST), and the Health Sciences Reasoning Test (HSRT) which also measures critical thinking skills and a self-efficacy for Nursing Skills Evaluation Tool. These instruments are well established and have been used in previous research studies assessing self-efficacy, critical thinking and learning styles of healthcare students. Students also completed a researcher developed knowledge questionnaire on the symptoms of heart failure. The experimental group then participated in a HF-HPS and completed the posttest knowledge questionnaire (posttest 1). Prior to the crossover the control group also completed the posttest 1 knowledge questionnaire. They then participated in the HF-HPS and completed the posttest knowledge questionnaire posttest 2. All students also completed a demographic questionnaire on age, gender, school and previous heart failure experience at posttest. Using multivariate analysis results indicated that the only statistically significant predictor of increase in knowledge of symptoms of heart failure was participation in

HF-HPS ($p < .01$). Based on this rigorous research design this study provides strong evidence that participation in a HF-HPS was an effective teaching tool to increase knowledge in participants regardless of learning style, critical thinking ability, self-efficacy or other demographic characteristics.

Communication. As with undergraduate medical education, communication skills are a critical component of nursing education and vital to the preservation of patient safety. HF-HPS can provide faculty with the opportunity to observe, evaluate and provide feedback to students on their communication skills. Despite this beneficial use only one recent study was found exploring the feasibility of HF-HPS as a viable tool to assess students' self-efficacy in their communication techniques.

In a non-random quasi-experimental design study Kameg, Clochesy, Mitchell, and Suresky (2010) compared the traditional didactic teaching method with HF-HPS as a means to evaluate the self-efficacy of communication skills in pre-licensure nursing students. A group of senior nursing students ($n = 38$) were divided into two groups; group 1 ($n = 21$) and group 2 ($n = 17$), and were then were assigned to either a psychiatric rotation or a community health rotation and switched half-way through their course. Group 1, who were in the psychiatric rotation attended a two-hour lecture on communication skills and then completed the study questionnaires: a demographic questionnaire, a 10- item General Self-Efficacy Scale which assessed their sense of how they cope with difficult and stressful situations, and a single item Self-Efficacy of Communication Skills measure. The students then participated in two HF-HPS scenarios (a patient experiencing anxiety and possible substance abuse and a patient with depression and attempted suicide). They then completed the same single item self-efficacy measure and a post-simulation satisfaction questionnaire. This same process was repeated for group 2, when the two groups switched at the half-way mark in the course. Independent t-test demonstrated a statistically significant increase in communication self-efficacy following the simulation experience ($p = .000$) as compared to the lecture only method of teaching. There was a moderate correlation ($r = 0.42$, $p = .009$) between General Self-Efficacy Skills and the Self-Efficacy in Communications Skills at time 1. Descriptive data for the simulation evaluation survey indicated that students felt the HF-HPS was a valuable experience and that it should be included in the curriculum. They also identified HF-HPS helped to stimulate critical thinking. It is interesting to note that students did not feel that simulation can be substituted for clinical experiences in the hospital. The authors conclude that this study lends support to the use of HF-HPS in assisting students to gain confidence in their communication skills.

Confidence. Seven recent studies were found that investigated HF-HPS and confidence levels of pre-licensure nursing students; there were two descriptive studies and five studies using quasi-experimental designs.

In a descriptive study by Bremner, Aduddell, Bennett, and VanGeest (2006) a group of novice nursing students ($n = 41$) completed a head to toe assessment using a HF-HPS prior to their first clinical experience. Students then completed a two-part questionnaire about their experiences. Results indicated 95% of students rated the experience from good to excellent, 68% felt the experience should be mandatory, 61% found the experience gave them confidence in their physical assessment skills and 42% felt that this educational strategy relieved the stress of the first day of clinical.

Traynor, Gallagher, Martin, and Smyth (2010) used a descriptive study to investigate the use of HF-HPS with senior nursing students ($n = 90$) in Ireland who were about to complete their final 14-week clinical placement before graduation. All students took part in three simulation scenarios which included a patient experiencing exacerbation of chronic obstructive pulmonary disease, a patient with a head injury and a post-operative patient. The study took place over an eight day period with sessions in the morning and afternoon and approximately six students participated per session. At the end of the three sessions students completed a 20-item five point-Likert scale evaluating the simulation experience. There was also an open-ended question for students to add comments. Results from the Likert scale identified that students felt participating in HF-HPS improved their confidence for their future practice, improved their organizational, clinical and diagnostic skills and overall was a useful learning experience. Interestingly when the nursing students were asked if they would welcome the opportunity to participate in a HF-HPS with medical students only 52% agreed. Five themes emerged from the open-ended questions. These are: “the reality of the simulation”, “the benefits of active learning”, “the experience of working as an autonomous practitioner”, “the importance of theory to practice”, and “the benefits of working in a safe environment”. The authors noted that exposing the participants who are about to graduate to a variety of complex clinical cases appears to improve their self ratings of their assessment skills, critical thinking and problem solving.

Brown and Chronister (2009) completed a correlational comparative research design study to assess the impact of HF-HPS on self-confidence and critical thinking when incorporated into an electrocardiogram (ECG) nursing course. A group of nursing students (n = 140) were recruited during two semesters and the course took place over seven weeks at the beginning of each semester. Students were randomly assigned into either the simulation group (n = 70) who participated in weekly simulations in addition to their regular didactic lectures or the control group (n = 70) who received only their weekly didactic lectures. At the end of the ECG course all students completed the demographic questionnaire, a researcher developed 5-item self-confidence tool, and the ECG SimTest, a 30-item multiple choice computerized exam evaluating critical thinking. Using a two-sample t-test no significant differences were found between the groups in self-confidence or critical thinking following their assigned method of teaching. In addition for educational benefit and ethical integrity, the control group also participated in a 40 minute simulation experience and completed the self-confidence tool again. Paired t-test results found a statistically significant difference ($p < .05$) on all five items of the self-confidence tool following participation in the simulation experience. The authors suggested that students who are better prepared in terms of knowledge to participate in HF-HPS may derive greater benefit from this educational technology as compared to students have more limited knowledge. Other individual-level variables may also account for self reports of self-confidence.

Bambini, Washburn, and Perkins (2009) used a quasi-experimental repeated measures design with a convenience sample of novice nursing students ($n = 112$) to explore the effects of simulation on the self-efficacy of the novice nursing student. The students who were preparing for their first clinical experience on a maternal-infant rotation completed the researcher developed pretest survey which was comprised of a 6 item 10-point Likert-scale indicating their level of confidence in various nursing skills required to care for a post-partum patient and newborn. The participants then took part in a three-hour simulation lab designed to help them prepare for their first clinical experience on the post-partum unit. The sessions involved a variety of simulations ranging from low, to medium, to high-fidelity scenarios. Following the sessions the students then completed the posttest survey and three open-ended questions. It was the intention of the researchers to complete a follow-up survey but due to low response rates the follow-up survey was not included in the findings. Results using t-test analysis found statistically significant differences in the overall self-efficacy of the students in caring for the post-partum patient after taking part in the simulation experience ($p < .01$). There were also significant increases in confidence for the individual skills assessed including: vital signs, assess fundus, assess lochia, patient teaching and overall ($p < .001$) and breast exam ($p < .01$). Three themes emerged from the qualitative data including communication both verbal and non-verbal, confidence in psychomotor skills and clinical judgment. Overall the students found the simulation experience to be valuable; students felt more confident in caring for a post-partum mother and newborn and they overwhelmingly enjoyed the experience. The authors concluded that this study provides support for the use of simulation in preparing nursing students for entering the actual clinical setting.

While the previous research studies provide some support for the use of HF-HPS over and above the traditional teaching methods to increase students' confidence, this is not a consistent finding. Brannan, White, and Bezanson (2008) found no differences in confidence levels when HF-HPS was compared to traditional classroom instruction to teach students core nursing content in caring for a patient experiencing an acute myocardial infarct (MI). The study was a quasi-experimental, pretest-posttest comparison group design. A group of first year nursing students ($n = 107$) from two schools of nursing who were enrolled in an adult health nursing course in the fall or spring semester participated. The students in the fall semester ($n = 53$) received the traditional didactic method of instruction. The students enrolled in the spring semester ($n = 54$) received instructions using HF-HPS. Prior to undergoing the designated method of instruction all students completed the pretest questionnaires which included a demographic form, a confidence level (CL) tool, and the Acute Myocardial Infarction Questionnaire (AMIQ) measuring their knowledge in caring for an MI patient. Following their method of instruction students completed the same AMIQ and CL questionnaires. Analysis of the data revealed that students receiving the HF-HPS method of instruction had statistically significant higher posttest scores on the AMIQ ($p = .002$). Both groups had considerable gains in their levels of confidence in caring for a patient experiencing an MI from pre to post instruction, but there were no statistically significant differences in confidence levels between the two groups ($p = .09$). The authors argued that a student's confidence after any teaching method would naturally be higher if they felt they met the learning objectives. They proposed that measuring the confidence levels of these students after caring for an MI patient in the clinical area might reveal whether the HF-HPS group was any more confident than their colleagues who had received the traditional classroom instruction only. The authors also suggested that this study supports the use of HF-HPS as learner-centered strategy which actively engages the student and may be useful in helping students gain knowledge in complex concepts such as caring for a patient experiencing an MI.

Blum, Borglund, and Parcells (2010) used a quasi-experimental study to examine the relationship between simulation, self confidence and clinical competence in pre-licensure entry-level nursing students ($n = 53$). All students were enrolled in the same 13-week didactic introductory assessment course and were assigned into either the control group ($n = 16$) who demonstrated their skill competency using the traditional approach or the experimental group ($n = 37$) who demonstrated competency using HF-HPS. All students completed the study tool which consisted of selected items from the Lasater Clinical Judgment Rubric (LCJR) measuring students' self-confidence and clinical competence at midterm and again during the final week of the semester. Data analysis indicated that both groups had statistically significant increases in their levels of self-confidence and clinical competence regardless of the learning modality ($p < .05$). There were no differences in the confidence levels of the students in either group at either of the two assessment points. The authors concluded that the traditional laboratory method of teaching, as well as the traditional method of return demonstration appears to be as effective as HF-HPS with entry-level nursing students in enhancing student self-confidence and competency. They also stated that this study contributes to knowledge development in nursing education by outlining an innovative way of evaluating student self-confidence and competence

Critical thinking. Another outcome often explored using HF-HPS with undergraduate healthcare students is that of critical thinking. Critical thinking, often interchanged in the literature with critical reasoning, is a core clinical competency and considered foundational for all nursing practice (Burns, O'Donnell, & Artman, 2010). Nursing educators strive to teach this requisite skill to undergraduate students in an attempt to prepare them to cope with the complexities of today's healthcare system. As with any skill a key in attaining competency is the opportunity to practice in a realistic, yet safe clinical environment. HF-HPS has been suggested as an alternate environment in which students can develop this required workforce competency (Banning, 2008; Burns, O'Donnell, & Artman, 2010; Fero et al., 2010; Goodstone et al., 2013; Lasater, 2007; Ravert, 2008; Shinnick & Woo, 2012; Sullivan-Mann, Perron, & Fellner, 2009; Trede & Higgs, 2008; Waldner & Olson, 2007). There are five recent quasi-experimental design studies exploring the relationship between HF-HPS and critical thinking in pre-licensure nursing students.

In a quasi-experimental design study Goodstone et al. (2013) compared HF-HPS to instructor written case-studies (low-fidelity) on the development of critical thinking in undergraduate nursing students (n = 42). Students were enrolled in their health assessment course in the first semester of their nursing program which consisted of one hour of lecture and three hours of lab per week. Students in the morning lab section were assigned to the HF-HPS (n = 20) group and participated in weekly simulation sessions and students in the afternoon lab slot were assigned to the case study group (n = 22) and participated in weekly paper-and-pencil case studies. The case study and simulation scenarios contained the same content and learning objectives. All students completed the Health Sciences Reasoning Test (HSRT) designed to measure critical thinking during week two of the semester and again during week 14. Results from the HSRT indicated that there were no differences between the two groups at pretest ($p = .74$), and both groups improved their HSRT scores on the posttest however scores were not statistically significantly different between groups. The authors concluded that this study supports the use of both high and low-fidelity simulations as a means to increase critical thinking test scores and that there is no clear supremacy for either method.

Sullivan-Mann, Perron, and Fellner (2009) used a pretest-posttest design study to assess the impact of HF-HPS on critical thinking in a group of undergraduate nursing students in a medical surgical course (n = 53). All students completed the Health Sciences Reasoning Test (HSRT) and were then randomly assigned to either the control group (n = 26) or the experimental group (n = 27). Both groups followed their normal curriculum outline which included two simulation scenarios scheduled during weeks 1 and 15 of the semester with the experimental group receiving additional simulation scenarios at weeks 7, 11, and 13. After the final simulation all students completed the HSRT as a posttest. Independent t-test indicated that there were no significant differences between the control and experimental group scores on the HSRT pretest ($p = > .05$). Results from the posttest indicated that the experimental group answered statistically significantly more questions correctly on the posttest ($p < .05$); the control group also improved but not significantly ($p > .05$).The authors concluded that the results clearly demonstrated that exposing students to additional simulation scenarios leads to an incremental increase in critical thinking scores and lends further support for the use of HF-HPS to teach critical thinking skills to undergraduate nursing students.

In a larger pretest posttest design study Shinnick and Woo (2013) examined the effects of HF-HPS on the knowledge and critical thinking of pre-licensure students from four schools of nursing in the United States. They also attempted to identify factors that would predict higher critical thinking scores such as learning style, age, self-efficacy, and HF-HPS experiences. All students ($n = 154$) were at the same point in their undergraduate curriculum and all students had completed their instruction on the care of a congestive heart failure (CHF) patient. Two days of data collection were scheduled at each site within 3 weeks of the CHF lecture. Students in groups of 5 to 6 rotated through the pretest, posttest and debriefings, but the HFS scenarios were one-on-one. All students completed the Health Sciences Reasoning Test (HSRT) which measure critical thinking, and the Kolb's Learning Style Inventory (LSI) online, prior to arriving at the simulator. Students completed a knowledge pretest, a demographic questionnaire and a 12-item 5-point Likert scale self-efficacy tool on the research day. Following their HF-HPS experience the participants were given a two-week timeframe in which to complete the posttest questionnaires including the HSRT, knowledge posttest and self-efficacy tool. Results indicated that there were statistically significant gains in the students' knowledge following participation in a HF-HPS ($p < .001$); however there were no statistically significant gains in critical thinking ($p = .76$). Using multivariate analysis the results indicated that the variables of older age ($p = .011$), higher baseline knowledge ($p = .039$) and lower baseline self-efficacy ($p = .022$) are predictive of higher critical thinking ability following participation in HF-HPS. While the results indicate that HF-HPS improves knowledge, the authors concluded that it does not equate to improvements of critical thinking ability.

Burns, O'Donnell, and Artman (2010) explored the use of HF-HPS to facilitate problem-solving in first year nursing students ($n = 114$), a pretest-posttest design was used to evaluate knowledge and attitude change following participation in a HF-HPS experience. All students received their traditional didactic lecture on the nursing process and within one week of the lecture all students completed the researcher developed 10-item multiple choice knowledge questionnaire and a 14-item attitude questionnaire. Students were then assigned into groups of six and participated in a 3-hour simulation experience and completed the posttest questionnaires. Results showed a significant increase in knowledge gains for the participants post participation in a HF-HPS ($p < .001$). Paired t-test for the attitudinal survey demonstrated a statistically significant improvement on 6 of the 14 items surveyed which included; critical thinking, overall nursing knowledge, specific skills in caring for patients, confidence in nursing skills, communication with patients and communication with other team members ($p < .01$ to $p < .0003$) Students reported high levels of satisfaction with the simulation experience. The authors concluded that HF-HPS as an adjunct to traditional lecture is an effective method in facilitating student knowledge acquisition and promoting a positive change in attitudes.

Ravert (2008) used a pretest-posttest design to examine differences in critical thinking between three groups of undergraduate nursing students in their first medical-surgical course. Students were randomly assigned into the experimental HF-HPS group ($n = 12$) which included their regular education process and weekly HF-HPS sessions for five weeks, the non-HF-HPS experimental group ($n = 13$) which included the regular education process and weekly small group discussions, or the control group ($n = 15$) who had their regular education process only. All students completed the California Critical Thinking Skills Test (CCTST) that measures core critical thinking skills, the California Critical Thinking Disposition Inventory (CCTDI) that measures dispositions in seven concepts of critical thinking, and the Kolb's Learning Style Inventory (LSI). Results from the study indicated that all three groups experienced an increase in their critical thinking scores on both the CCTST and the CCTDI, with the effect size in moderate to large range. No statistically significant differences were detected between the groups but this may have been due to the small sample size. Results from the LSI indicated that learning styles did not account for the increase in critical thinking scores. However, the authors stated that students who prefer experiential learning styles may choose HF-HPS experiences to enhance their learning whereas those who like reflective learning may be more inclined to choose group discussions. They further concluded that since there were no differences in critical thinking between the three groups and students should be given a choice of their learning experiences, HF-HPS, small group discussions or traditional didactic learning.

Clinical placement shortage. There is an emerging concern of finding adequate and suitable clinical placements for undergraduate nursing students and subsequently there are nursing schools in the United States, which have approved the use of HF-HPS as a substitute for the required clinical placement hours. The state of Colorado for example allows up to 15% of the required clinical time for nursing students to be completed in the HF-HPS setting (Smith & Roehrs, 2009). It has been acknowledged that simulation can never replace actual clinical experiences but it is a very useful tool for creating realism in allowing students to practice their skills before performing them on an actual patient (Lasater, 2007; Neil, 2009).

New research has been completed on the ability of HF-HPS to replace clinical hours in undergraduate nursing education. A recently published large scale longitudinal randomized controlled study by Hayden, Smiley, Alexander, Kardong-Edgren, and Jefferies (2014) found strong support of HF-HPS in replacing up to 50% of the required clinical hours of pre-licensure nursing students. In their study nursing students (n = 666) from 10 different schools of nursing across the United States were randomized into three groups: the control group (n = 258), the group who received 25% of their clinical hours in the HF-HPS (n = 288) and the group who received 50% of their clinical hours in the HF-HPS (n = 288). Data collection instruments included a demographic questionnaire, the Creighton Competency Evaluation Instrument (CCEI), Assessment Technologies Institute (ATI) Content Mastery Series Examinations, Clinical Learning Environment Comparison Survey (CLECS), End-of-Program survey, ATI RN-Comprehensive predictor, Follow-up survey and manager survey. Evaluation at the end of their respective nursing programs revealed no statistically significant differences in the clinical competency as assessed by instructor and preceptors (p = .688), knowledge assessment (p = .478) and the NCLEX pass rates (p = .737) amongst any of the three groups of students. There were no differences in manager ratings of overall clinical competency and readiness for practice at any of the follow-up survey times: 6 weeks (p = .706), 3 months (p = .511) and 6 months (p = .527) in their first year in practice. There were no statistically significant differences amongst the new graduates regardless of their program of study. The authors state that these research findings are strong in providing evidence to support the use of HF-HPS as a viable substitute for up to 50% of clinical hours. To date there are no known schools of nursing in Canada replacing required clinical hours with simulation hours (Hayden, Smiley & Gross, 2014).

Summary. In summary, HF-HPS has great potential to augment undergraduate nursing education. Students have reported an increase in self- confidence and satisfaction following their HF-HPS learning experience (Bambini, Washburn, & Perkins, 2009; Bremner, Aduddell, Bennett, & VanGeest, 2006; Brannan, White, & Bezanson, 2008; Brown & Chronister, 2009; Smith & Roehrs, 2009; Traynor, Gallagher, Martin, & Smyth, 2010). There seems to be adequate findings to support HF-HPS as a means to improve student knowledge and skill acquisition (Kardong-Edgren, Anderson, & Michaels, 2007; Hoffmann, O'Donnell, & Kim, 2007; Kirkman, 2012; Shinnick, Woo, & Evangelista, 2012). Other studies have supported the use of HF-HPS as a means to improve students' critical thinking (Goodstone et al., 2013; Ravert, 2008; Shinnick & Woo, 2012; Sullivan-Mann, Perron, & Fellner, 2009). However based on the current evidence it cannot be stated definitively that HF-HPS improves student critical thinking.

Researchers and educators have argued that inundating students with lectures devoid of clinical experiences can make them aware of relevant theories but it is not adequate enough to prepare them for the complexities of today's practice environment. Thus clinical simulation is gaining and will likely continue to gain popularity as a powerful tool to meld theory and practice (Bruce, Bridges, & Holcomb, 2003; Decker, Sportsman, Puetz, & Billings, 2008; Jefferies, 2005). However, the research evidence had not found HF-HPS to superior to our current method of teaching. To date many of the studies have weak research designs, lack a control group and use small sample sizes. Many of the tools used to measure outcomes are often developed by the researcher, with limited psychometric information. The studies are often a onetime experience which makes it impossible to make generalizations about the widespread effects of simulation. There is evidence to state fairly confidently that HF-HPS is as good as our current teaching curriculum in enhancing, knowledge, confidence and skill acquisition and that it is a valuable adjunct to the didactic method but at this point in time one cannot state that it is superior.

High Fidelity Human Patient Simulation in Pharmacy Education

The use of HF-HPS in undergraduate pharmacy education is relatively new compared to its use in medicine and nursing. However there has been an increase in incorporating HF-HPS into pharmacy curricula in the past eight to ten years. Educators in the discipline of pharmacy are beginning to utilize HF-HPS as an adjunct to their traditional lecture style of teaching. It is noteworthy that the Accreditation Council for Pharmacy Education Standards and Guidelines in the United States (2011) allows for simulation based activities to account for up to 20% of pharmacy students' practice experience. Consequently there has been increase in research in the past five years using high fidelity simulation based learning with pharmacy students. A total of seven recent studies were reviewed that explored HF-HPS as a teaching tool in pharmacy education; two used experimental designs, four used quasi-experimental designs, and one was a survey.

As with the disciplines of medicine and nursing there has been research to explore the use of HF-HPS as a means to improve pharmacy students' knowledge, skill and confidence. In a recent study, Davis, Storjohann, Speigel, Beiber, and Barletta (2013) used a randomized parallel group, sequential, crossover trial to evaluate HF-HPS as a teaching technique to improve knowledge, confidence and overall satisfaction of fourth year pharmacy students. Students enrolled in the Advanced Cardiac Life Support (ACLS) course were randomized into either group 1 ($n = 74$) who received the traditional lecture first and HF-HPS second or group 2 ($n = 75$) who received HF-HPS first and the traditional lecture second. Participants completed a knowledge-based examination and two Likert-scale questions rating their confidence in their ACLS knowledge and skills performance at baseline and following each learning experience. A satisfaction survey was also completed at the end of the experience. Results showed that test scores improved significantly in both groups from baseline. When teaching methods were assessed at each endpoint, there was a 38.1% increase with lecture only, 32% for HF-HPS only, 41.4% HF-HPS followed by lecture and 43% for lecture followed by HF-HPS ($p = .003$). There were no significant differences in confidence with drug knowledge between the participants following the HF-HPS compared with the lecture. A significant number of students felt more confident in their ACLS skills following simulation as compared with the lecture ($p = .009$) and more students strongly agreed that they were more satisfied with the HF-HPS experience compared to the lecture. Eighty four percent of the students preferred the lecture followed by the HF-HPS exercise as compared to the other formats. The authors concluded that HF-HPS should be incorporated into the ACLS curriculum as an adjunct to the current teaching method. They also felt that this study was unique in that it captured baseline knowledge of the student as well as knowledge improvement with individual as well as the combined teaching techniques.

Similarly, in a randomized, crossover design study Seybert, Smithburger, Kobulinsky, and Kane-Gill (2012) compared problem-based learning (PBL) with simulation-based learning (SBL) in a group of pharmacy students ($n = 29$) enrolled in the Acute Care Pharmacotherapy Simulation course. Following orientation and the initial assessment students were randomized into two groups during week one. Group 1 participated in SBL and group 2 participated in PBL; the groups switched at week two. Students' knowledge was assessed at baseline and again following their intervention. The baseline assessment included a multiple choice and short answer quiz. The post intervention assessment involved the same quiz as well as an individual clinical assessment involving a HF-HPS scenario graded by faculty. Students were also given the opportunity to comment on the type of instruction they preferred and which method they felt increased their confidence and ability to care for patients. Results indicated that there were no significant differences in scores at baseline; however the SBL group had statistically significantly higher posttest scores compared to the PBL group ($p < .001$). Students in the SBL group also performed statistically significantly better in their clinical assessment scores compared to the PBL group ($p < .05$). The majority of students prefer SBL to PBL (76%) and eighty-six percent of students felt that SBL will increase their ability to care for patients compared to PBL in the actual clinical setting. All students felt that SBL increased their confidence. From these findings the authors concluded that learning was enhanced with the hands-on experience offered by SBL as compared to PBL style.

In a pretest- posttest design study Seybert, Kobulinsky, and McKaveney (2008) explored HF-HPS as an effective tool to reinforce the theoretical classroom learning. Pharmacy students ($n = 102$) enrolled in the Pharmacology of Cardiovascular Disease course participated in HF-HPS cases to augment their traditional didactic lectures. Students were divided into groups ($n = 15$) of 6 or 7 students for the simulation sessions. All students completed pre and post simulation surveys rating their confidence in the management of the various cardiovascular cases covered in the course. As well knowledge pretest and posttest on dysrhythmias management and the counselling of patents with a myocardial infarction (MI) were competed. Results indicated statistically significant responses for four of the seven questions rating their confidence in performing physical assessments and interpreting patient data following participation in the simulation course ($p < .05$). Statistically significant results were reported by the participants on all five questions regarding the management of dysrhythmias following the HF-HPS ($P < .05$). Students also reported statistically significant results for two of the five components in their knowledge of counselling patients with acute MI. High levels of satisfaction with the HF-HPS were reported by the students in this study and they scored higher on their post simulation examination in terms of knowledge and confidence in their pharmacotherapy and patient assessment skills. The students groups also completed a final simulation case where 10 of the 15 groups received 100% of the available points with a 95.8 % average score for all the groups. The authors concluded that HF-HPS provides a unique opportunity for pharmacy students to practice their problem solving skills and achieve clinical competence in a safe immersive and engaging learning environment.

Another recent pretest-posttest study by Branch (2013) found positive results when using HF-HPS to evaluate students' clinical competence, knowledge and satisfaction. A group of second year pharmacy students ($n = 123$) were randomly assigned into groups of eight or nine to take part in a HF-HPS scenario involving a patient with non-steroidal anti-inflammatory drug-induced dyspepsia. Students completed a pre and post simulation 7-question knowledge test and the student groups scenarios were evaluated for their application of knowledge, communication, problem solving and clinical skills using a performance checklist developed by the researcher. Students also completed a post-simulation 5-point Likert type scale satisfaction survey evaluating their experience. Paired t-tests of the knowledge scores were statistically significant following the simulation ($p < .001$) with the mean scores increasing from 44% on the pretest to 63% on the posttest. The student groups ($n = 15$) scored an average of 60% on the performance checklist with the scores ranging from 48-85%. The satisfaction surveys indicated that students liked the "hands on" approach provided by the simulation experience. Students felt it "mirrored" real life and it should be used more often in pharmacy curriculum. Branch (2013) stated that this study demonstrated that participation in a HF-HPS learning helps to improve student knowledge and prepare them for entry into the workplace as competent practitioners. She also noted that the implementation of student feedback comments from the simulation experience can be an effective means of improving curriculum.

A more recent pretest-posttest design study by Eng et al. (2014) utilized HF-HPS as an adjunct to the existing traditional teaching to assess pharmacy residents' knowledge, confidence and competency with advance resuscitation interventions. At the start of their program a group first year pharmacy residents (n = 12) had participated in their traditional advanced resuscitation training (ART) workshop, which involved formal instruction, medication review and interactive task-based training. Six months following the initial ART course a HF-HPS became available for pharmacy students education training. Consequently these same group of students participated in a pilot HFS-ART course. Three weeks prior to the implementation of the HFS-ART course all students completed pre simulation assessment tools which included the 20-question multiple-choice knowledge exam, 10-question 5-point Likert scale confidence survey and 20 minute HF-HPS resuscitation scenario to evaluate their competency in advanced resuscitation skills. All students then participated in the HFS-ART course which included an ART didactic review, medication preparation and calculation review, and a demonstration of a HF-HPS resuscitation case. Students were then divided into groups of 4 and each group participated in two facilitated HF-HPS resuscitation scenarios where students were given the opportunity to play different roles including the primary cardiac arrest team pharmacist. Three weeks later the student groups participated in another HF-HPS resuscitation scenario completed the same knowledge and confidence questionnaires and their competency was evaluated during a HF-HPS resuscitation scenario. The results on the multiple choice exam showed a statistically significant increase from 65% on the pre-simulation exam to 88% on the post simulation exam ($p = .001$). Students competency assessment scores were 64% on the pre-simulation versus 77% on the post-simulation assessment ($p = .009$). Median confidence scores increased from 3.2 to 4.0 ($p = .001$) following the HF-HPS experience. The authors concluded that this study demonstrated positive results to support the use of HF-HPS as an adjunct to the traditional lecture in teaching pharmacy students advance resuscitation skills. Based on this study the Resuscitation Director and Code

Blue Committee at this institution have sanctioned the use of HF-HPS to be incorporated into the annual training of pharmacist in their resuscitation skills.

In a survey study by Fernandez, Parker, Kalus, Miller, and Compton (2007), a group of pharmacy students (n = 73) enrolled in their second year of study participated in a simulation exercise. The pharmacy students worked in teams to assess and make treatment recommendations for an acutely ill hypertensive patient. Following the HF-HPS experience students completed a satisfaction survey. Results of the survey showed that 98% agreed or strongly agreed that the material was relevant to their future practice, and 95% of the students felt that simulation would enhance their knowledge base and better prepare them for future clinical practice. As well 90% felt that simulation learning helps them to learn clinical patient care better as compared to the traditional lecture and 89% of students really enjoyed the simulation experience. The authors stated that HP-HFS may provide a better environment as compared to the lecture in which to teach certain topics to pharmacy students. They also concluded that HF-HPS offers a realistic environment in which clinical knowledge and interpersonal teamwork skills can be taught.

While the evidence supports that HF-HPS improves knowledge acquisition in pharmacy students, it does not necessarily equate to knowledge retention. In a randomized, parallel group design study Ray, Wylie, Rowe, Heidel, and Franks (2012) evaluated student’s retention of knowledge following HF-HPS as compared to written case scenarios. A group of fourth year pharmacy students (n = 26) enrolled in the Drug-Induced Disease Course were randomly assigned into either the HF-HPS case teaching method (n = 13) or the written case-based method (n = 13). Students’ knowledge was assessed using a 25-question multiple-choice exam at three different intervals: before the case (pretest), immediately following the case (posttest) and 25 days after the case (retention test). Students also completed a 5-statement survey instrument to evaluate their perception of the experience including their comfort levels. A mixed ANOVA was used to test for significant main effects across time and between the learning interventions. Results indicated that participation in the HF-HPS case teaching method did not result in greater knowledge retention ($p = .85$) or in greater levels of comfort compared to those participating in the written case-based method. Student knowledge and level of comfort improved post-intervention regardless of the teaching method. From this study the authors concluded that the role of HF-HPS in pharmacy education is still unclear however they stated that because of the students' overwhelming enthusiasm for simulation learning, further research in this area is warranted.

Summary. There is increasing data being published exploring the use of HF-HPS in undergraduate pharmacy education in the areas of enhancing student knowledge, skills and confidence. Despite the increase in interest and research amongst pharmacy faculty members regarding the benefits and use of HF-HPS there are limited studies with pharmacy students that use strong experimental designs. The majority of the research to date has used small sample sizes without a control group. The studies often involve only one simulation experience and therefore make it very difficult to make inferences and generalizations as to the effect of HF-HPS in pharmacy education on a more global scale. All of the studies reviewed suggest that there is evidence to support HF-HPS in pharmacy curricula as an adjunct to the current method of teaching, but more research is needed.

Interprofessional Education and Collaboration

There are few research studies exploring the relationship between HF-HPS and IPE (Reese, Jefferies, & Engum, 2010). The concept of bringing students from different disciplines together in the safe environment of the HF-HPS and allowing them to practice their requisite skills without the risk of causing harm to a patient has the potential to be the ultimate IP learning experience (Reese et al., 2010). Effective collaboration and teamwork are necessary for patient safety and requires the collaboration of many individuals with different roles, training and experiences (Wright & Endsley, 2008). Many pre-licensure educational programs educate their students without providing insight into the roles and responsibilities of the other members of the healthcare team. Compounding this problem is evidence to suggest that negative attitudes towards other healthcare professions often develop early in undergraduate students. If these negative attitudes are present effective collaboration and teamwork may be impeded and consequently patient safety may suffer (Curran, Sharpe, & Forristall, 2008). While IPE is becoming core content in undergraduate healthcare education curriculum there is a shortage of research exploring the use of HF-HPS as a viable teaching modality for undergraduate pre-licensure students to come together and practice their skills in a safe, controlled environment. A total of nine recent studies were found exploring the use of HF-HPS with groups of interprofessional undergraduate heath sciences students: one used an experimental design, five were quasi-experimental, two were surveys and one was descriptive.

Teamwork and communication. There has been an emerging trend to incorporate HF-HPS into the undergraduate IPE curricula. Educators are recognizing the potential of HF-HPS as a viable solution for enhancing undergraduate health sciences students' learning by allowing them to practice collaborating with students from various healthcare disciplines (Clark et al., 2010). Seven recent quasi-experimental design studies were found that incorporated HF-HPS as part of IPE curricula to enhance teamwork and communication skills amongst undergraduate healthcare students.

In a quasi-experimental design study Garbee et al. (2013) evaluated the effects of interprofessional HF-HPS on student's acquisition and retention of teamwork behaviours and communication skills with a convenience sample of nurse anaesthesia, nursing, medical and respiratory pre-licensure students ($n = 52$). The IP teams consisted of at least one member from each of the aforementioned professional disciplines and each team participated in two HF-HPS scenarios in the fall semester and the same scenarios again during the spring semester. Three tools were used to measure team behaviours: the Communication and Teamwork Skills (CATS) tool, the Teamwork Assessment Scale (TAS) which is a modification of the Operating Room Teamwork Assessment Scale (ORTAS) and the Mayo High Performance Teamwork Scale. These tools have been used in previous research evaluating team performance and have good reported inter-rater reliability, validity and internal consistency. Paired t-test indicated a statistically significant increase in teamwork behaviours from scenario 1 to scenario 2 in the fall semester ($P < .05$) and a statistically significant increase in teamwork behaviours from scenario 2 in the fall to scenario 1 in the spring ($P < .05$). There was also improvement in scores from scenario 1 in the spring to scenario 2; however the results were not significant. The authors stated that the results of this study provide evidence of retention of teamwork skills by the students following HF-HPS training. The authors concluded that this study provides support for the feasibility and efficacy of HF-HPS as an innovative and valuable setting for teaching teamwork and communication skills in undergraduate education.

Scherer, Meyers, O'Connor, & Haskins, (2013) used a pretest posttest design to investigate the effects of HF-HPS interprofessional education compared with HF-HPS intraprofessional education on knowledge, confidence and attitudes towards interprofessional learning, teamwork and collaboration with a convenience sample of senior nursing students (n =

85) and medical students ($n = 23$). The students were randomly assigned to either an intraprofessional nursing only group ($n = 37$) which served as the control group or the experimental (interprofessional) group comprised of medical ($n = 23$) and nursing ($n = 48$) students. Both groups had completed the traditional didactic lecture on the management and care of a cardiac patient. Students completed the study questionnaires before and after their HF-HPS experience which included a knowledge test, confidence scale, the Readiness for Interprofessional Learning Scale (RIPLS) and the Attitudes Towards Healthcare Teams Scale (ATHCTS) as well as a researcher developed post-satisfaction questionnaire. Results indicated that mean knowledge scores increased significantly for both the medical and nursing students in the experimental group post simulation, but not for the nursing only group ($p > .05$). Confidence levels for all three groups improved significantly ($p \leq .05$) following the simulation intervention. Students in the experimental group also scored significantly higher on the three subscales of the RIPLS: teamwork and collaboration, professional identity and roles and responsibilities as compared to the nursing only group ($p \leq .05$) post simulation. Scores on the ATHCTS showed a significant increase in the subscales that addressed team values and efficiency following participation in HF-HPS ($p \leq .05$) for both the experimental and control groups. The authors concluded that the results support the use of HF-HPS as a means to facilitate IP teamwork and collaboration amongst medical and nursing students. They also state that HFS using an IPE framework helps to improve student attitudes towards IP learning and teamwork.

Tofil et al. (2014) utilized HF-HPS in a pretest-posttest design to evaluate knowledge, teamwork and communication in senior nursing and medical students. A convenience sample of medical students ($n = 72$) and nursing students ($n = 28$) were assigned to teams of eight or nine. The interprofessional student teams participated in 4, one-hour simulations over an eight week period. All students completed a researcher developed tool assessing knowledge and self-efficacy related to professional roles and attitudes towards team communication pre and post test as well as a post-simulation evaluation survey. Results indicated a statistically significant change in knowledge for students in both medicine ($p < .0001$) and nursing ($p = .003$) and statistically significant improvements were demonstrated in self-efficacy for both groups ($p < .0001$) following their participation in a high-fidelity simulated interprofessional clinical experience (SICE). Post simulation evaluations indicated that students felt the experience was valuable and the most common comments from the students were that they felt an improved sense of teamwork and communication as a result of participating in the HF-SICE. The authors concluded that interprofessional simulations have the potential to increase communication and team role attitudes in undergraduate healthcare students.

Similarly in a pre-post simulation survey study Bolesta and Chmil (2014) found that students' attitudes towards interprofessional education improved following participation in a HF-HPS. A group of pharmacy ($n = 61$), nursing ($n = 13$), and an unspecified major ($n = 1$) were assigned to interprofessional groups. All students completed the pre and post simulation surveys which were based on the Readiness for Interprofessional Learning Scale (RIPLS) and included additional items assessing students' opinions on how IPE affects certain discipline specific abilities such as communication and attitudes. Statistically significant changes ($p < .05$) from pre to post test were reported for five of the eighteen survey items including thinking more positively and wanting to collaborate with other professions, feeling it helped them become better team members, feeling it was necessary to work with other healthcare students, and better understanding of their professional role as a result of the experience. Students were also asked to rank seven elements used during the IP experience. Students ranked communication skills and team collaboration the highest. The authors stated that this study demonstrated that interprofessional simulation experiences have the ability to improve student's attitudes towards IPE as well as better prepare them for future IP experiences. They also stipulated that further research is warranted to evaluate the impact of IPE on student learning.

Similarly in a small descriptive study by Reese, Jefferies, and Engum (2010) a convenience sample of medical students (n = 13) and nursing students (n = 15) utilized HF-HPS to measure students' satisfaction and confidence following participation in a HF-SICE. The Nursing Education Simulation Framework (NESF) developed by Jefferies (2005) was used as a theoretical model to guide this study. All students received the traditional didactic lecture as well as their clinical component in caring for post surgical and cardiac patients. Students were then paired into interprofessional groups where one group participated in a HF-HPS and another group watched via closed circuit television. Differences between the medical and nursing student groups on simulation design features including satisfaction, collaboration and self-confidence were measured following the experience. Study results indicated that there were no statistically significant differences between the mean scores for the medical and nursing students on the simulation design, satisfaction and confidence scales. All students felt confident in caring for a patient with complications, expressed high levels of satisfactions and had high ratings on collaboration. The authors concluded that the results of this study support the use of the NESF to design high-fidelity simulations and simulations developed using this model will provide an environment in which students from different disciplines can practice and learn problem solving in a non-threatening safe environment.

Luctkar-Flude et al. (2010) used a mixed methods design study within the framework of a larger action research study to evaluate the addition of HF-HPS sessions to the cardiac resuscitation module with a group of undergraduate medical and nursing students. In this study the students who had participated in the initial pilot project consisting of two IP 2-hour cardiac resuscitation rounds sessions were the control group (n = 21) and the students who participated in the newer cardiac resuscitation curriculum which consisted of skills lab and three 2-hour IP cardiac resuscitation rounds using HF-HPS were the experimental group (n = 50). Following their method of instruction the students completed a demographic questionnaire, a 9-item communication and teamwork survey, 8-item confidence scale and four open-ended questions related to their comfort with IP learning, the challenges and benefit of IP learning as well as suggestions to improve the IP cardiac resuscitation module. Results found no statistically significant differences on the communication and teamwork questionnaire between the experimental and control groups; not between the medical and nursing students. Students in the experimental group scored statistically significantly higher on only one of the item in the confidence scale: “more confident in managing the airway”. There were no significant differences in the mean scores for the medical versus the nursing students on the confidence scale. Results from the open-ended questions indicated that students in the experimental group felt that IP learning was beneficial because it helped them “to see different points of view”, “gives them a better understanding of the different professional roles”, “encourages communication”, “helped to improve teamwork skills”, and “a great way to learn about other professions”. As well students reported that they really enjoyed the IP simulation sessions. The authors were surprised at the lack of significant findings and suggested this may be due in part to the quality of the evaluation tools, small sample size or the fact that there was no pretest to evaluate the effectiveness of the sessions. Nonetheless this module has been successfully incorporated into the curricula of the Schools Nursing and Medicine at Queen’s University, Ontario and the results of this study has provided feedback for the ongoing restructuring of the cardiac resuscitation simulation module. The author's further state the lack of significant findings makes it difficult to say that the addition of the IP skills lab and HF-HPS sessions actually made a difference in the students IP collaboration or their confidence in performing resuscitation skills. However it is noteworthy that the feedback from graduates, clinical faculty and clinical partners indicate that the new graduates from this university are demonstrating an improvement in handling emergency situations.

Dillon, Noble, and Kaplan (2009) utilized a pretest-posttest design to evaluate HF-HPS as an educational strategy with a convenience sample of senior medical ($n = 9$) and nursing students ($n = 31$). A pretest-posttest design was used to assess the student's perceptions towards interprofessional collaboration using HF-HPS. Prior to participation students completed a demographic questionnaire, as well as the Jefferson Scale of Attitudes Toward Physician-Nurse Collaboration and four open-ended questions ascertaining their perspective on nurse-physician collaboration pre and post participation in the IPE experience. Results indicated a statistically significant increase in the medical student's scores for two of the factors on the Jefferson Scale these included: interprofessional collaboration and nurse autonomy ($p < .05$). Answers to the open-ended questions revealed common themes of teamwork and communication. After the experience both nursing and medical students described the experience as "great", "a great opportunity to learn to work together", "I learned that nurses and doctors work together more than I thought" and "wonderful learning experience, one that should be continued". The authors conceded that while this is a small study it still gives credence to the value of HFS as a valuable IP educational tool.

In a larger quasi-experimental design study Aliner et al. (2014) used HF-HPS to evaluate undergraduate health sciences students' knowledge and perception of other healthcare professions. A group of students (n = 237) from a variety of health professions were divided into interprofessional teams and semi- randomized based on the order of their arrival to either the control (n = 118) or experimental group (n = 119). Before the simulation both groups completed the demographic questionnaire (Q1) and the control group also completed questionnaire two (Q2) which asked questions pertinent to the participant's views on IPE and interprofessional teams. The experimental group completed Q2 following their HF-HPS experience and as well completed a post simulation evaluation questionnaire. Analysis of the questionnaires showed a small but statistically significant difference between the groups on four of the five items with students in the experimental group expressing more positive attitudes towards interprofessional teamwork and IP learning following the simulation experience.

Smithburger, Kane-Gill, Kloet, Lohr, and Seybert (2013) used a post-simulation survey to evaluate HF-HPS as a means to allow students from pharmacy (n = 2), nursing (n = 2), medicine (n = 1), social work (n = 1) and physician assistant (n = 2) to come together to work on their communication and teamwork skills. Once weekly for a 4-week period this interprofessional team of students worked together to manage complex patient cases. Following the four HF-HPS experiences the students completed a survey evaluating their perception of the benefits of HF-HPS for IPE. Teamwork behaviors were also evaluated during each of the HF-HPS by two independent faculty members independent of the course using the Communication and Teamwork Skills (CATS) tool. This tool was specifically designed to evaluate overall team performance in relation to four main teamwork behaviors which include: coordination, situational awareness, cooperation and communication. Results from the CATS tool showed a significant improvement in the overall teamwork from HF-HPS session 1 to HF-HPS session 2 (p = .01), and again from HF-HPS session 2 to HF-HPS session 3 (p = .035) and from HF-HPS session 1 to HF-HPS session 4 (p = .001). However there was not a significant improvement from session 3 to 4 (p = .07). The results of the student perception survey reported high mean scores greater than 4 out of 7 for all seven of the items concerning the use of HF-HPS to improve their ability to communicate with other health professionals, their confidence in patient care in an IP team, stimulated student interest in IP work and was an efficient use of student time. All students strongly disagreed that there were too many simulation sessions during their IP experience. According to the authors this study indicated that students are very receptive to IP HFS as a means to practice their interprofessional teamwork and communication skills. The study results indicated that these behaviors improved with practice as indicated by the CATS tool scores.

Summary. In summary, interprofessional collaboration is seen as a vital component of undergraduate healthcare education curricula. Participants of HF-SICE have reported increased knowledge and awareness of the roles and responsibilities of the various members of the healthcare team (Scherer et al., 2013; Tofil et al., 2014). HF-HPS has been shown to improve interdisciplinary team collaboration, knowledge and team performance of undergraduate healthcare students (Dillon, Noble & Kaplan, 2009; Smithburger, Kane-Gill, Kloet, Lohr, and Seybert, 2013). There is a growing body of evidence supporting IPE as a means to promote positive attitudes and team collaboration (Aliner et al., 2014; Dillon, Noble & Kaplan, 2009). As well the evidence supporting the use of HF-SICEs to promote interprofessional collaboration, communication and teamwork amongst pre-licensure students is growing. Many of the studies reviewed have small sample sizes, taking place at only one institution thereby limiting its generalizability. Tools evaluating team performances and collaboration lack robust psychometric properties and are not widely applicable over the diversity of interprofessional teams. Therefore, further rigorous research is required to establish valid and reliable tools to evaluate outcome measures and establish a strong body of knowledge supporting the use of HF-SICE as a means of improving teamwork, communication and collaboration.

Conclusion

The research to date provides evidence to support the use of HF-HPS simulation in enhancing the knowledge and skills in undergraduate healthcare students' education. Nursing, medicine and pharmacy have utilized HF-HPS in intraprofessional research to enhance assessment, critical care management and communications skills within their respective undergraduate programs (Hoffman, O'Donnell & Kim, 2007; Kardong-Edgren, Anderson, & Michaels, 2007; Marshall, Harrison, & Flanagan, 2010; McCoy et al., 2010). HF-HPS has also been used with success to enhance the competence and confidence of the students in their respective programs of study prior to entering the actual healthcare setting (Bremner, Aduddell, Bennett, & VanGeest, 2006; Deering et al., 2006; Shukla et al, 2007). As well nursing researchers have attempted to provide support for the use of HF-HPS to improve critical thinking of nursing students, but the evidence to date is inclusive and more research is needed in this area (Burns, O'Donnell & Artmann, 2010; Ravert, 2008; Seybert et al., 2012; Shinnick & Woo, 2013; Sullivan-Mann, Perron & Fellner, 2009). Of late HF-HPS is being utilized to enhance teamwork and collaboration skills in undergraduate interprofessional education (Garbee et al., 2013; Scherer et al., 2013; Tofil et al., 2014). Of the studies reviewed using HF-HPS with interprofessional teams there have been reported increases in knowledge, communication and team collaboration skills. In the one study reviewed in which a direct comparison of intraprofessional teams to interprofessional teams was used, the study results showed statistically significant increases in knowledge, teamwork and collaboration for the interprofessional team following their HF-HPS experience as compared to the intraprofessional teams comprised of nursing students only (Scherer et al., 2013).

The majority of research studies reviewed in this chapter had relatively small sample sizes and often used tools with limited psychometric properties. However despite the limitations of the research, HF-HPS is increasingly being incorporated into the curricula of undergraduate health sciences students. Students are embracing this innovative teaching modality and are reporting high levels of satisfaction with their learning experiences using HF-HPS.

This pilot study is an attempt to investigate the use of high-fidelity simulated interprofessional clinical experiences (HF-SICEs) to improve the attitudes, collaboration and teamwork of undergraduate healthcare students. If these outcomes are positive, this will lend support for further, more rigorous research in this emerging, innovative educational area. The ultimate goal is to improve patient safety by enhancing these core clinical competencies of future healthcare professionals.

Chapter 3: Methodology

This chapter describes the methods used to investigate the research questions in this pilot study including: the study design, the sample the description and recruitment, the setting, data collection, data analysis methods, and ethical considerations. A description of the clinical case used in the simulation scenario is also described.

Study Design

This research study utilized a quasi-experimental descriptive design to assess the impact of a High-Fidelity Simulated Interprofessional Clinical Experience (HF-SICE) on the attitudes, collaboration and teamwork of pre-licensure health sciences students. Pre-licensure students from medicine and nursing participated in a HF-SICE and their attitudes towards interprofessional education and interprofessional healthcare teams were evaluated before and after the simulated experience. The simulations were videotaped and analyzed for the demonstration of teamwork behaviours by the pre-licensure students.

Sample

Convenience samples of pre-licensure medical and nursing students were recruited to participate in this study. Nursing students were either in a four year regular stream Bachelor of Nursing (BN) program or in a two year fast-track BN program. Fast track students had a bachelor degree or higher in another discipline or had advanced academic standing on admission to the nursing program. Nursing students in this study were eligible for enrollment in either their third or fourth year of the regular stream program and fast track students were eligible if they were in the second year of their program. Medical students had to be in either their third of fourth year of pre-licensure study. This eligibility requirement was to ensure that both nursing and medical students had the necessary in class lectures and background knowledge to participate in the clinical scenario in order to make care decisions for the simulated patient and not feel overwhelmed because of their lack of preparation. Participation was strictly on a volunteer basis and students were assured that no academic prejudice would result if they chose not to participate.

Recruitment

Initially, it was planned to recruit approximately 100 students to participate in the study from the Faculty of Medicine and the Schools of Nursing and Pharmacy, Memorial University of Newfoundland. Ethics approval was granted in the fall of 2011 and extended fall 2012 (see Appendix A) and posters advertising the study were displayed around the three faculties (see Appendix B) after obtaining permission from the Dean of the School of Pharmacy (see Appendix C), the Dean of the School of Nursing (see Appendix D) and the appropriate physician academic staff member from the Faculty of Medicine (see Appendix E).

The class president from the Schools of Pharmacy was contacted and he placed the study poster on the Pharmacy class' Facebook© page and a clinical pharmacist supervising pharmacy students in the intensive care unit also distributed the posters to her students. Medical students doing their surgery rotation were informed about the study by their team supervisor and the nursing students were informed through nursing faculty and the research posters. As a result of this initial recruitment strategy conducted over two academic semesters; (fall 2011 and winter 2012), three pharmacy students, and 20 nursing students expressed interest in participating in the study. However, no medical students contacted the researcher. During the spring semester (2012) only the fast track nursing students were on campus. As a result recruitment was suspended for this semester.

Prior to commencing study recruitment in the fall 2012 semester, the researcher submitted a request to the ethics committee, revising the recruitment process in order to offer participants of each discipline an opportunity to win a gift certificate valued at $75 for a local food establishment. Ethics approval for this incentive was granted (see Appendix F) and again posters advertising the study and the incentives were posted in the three faculties.

Additionally in April, 2012, the Memorial University of Newfoundland, Vice President's Instructional Development Grant for Innovative Teaching was awarded to support this research. The grant money was used to hire research assistants (RAs) to help recruit potential participants from the three heath sciences disciplines. The researcher met with potential RAs who were students from medicine, nursing and pharmacy and after consultation with them it was decided that the optimal time for recruitment and study participation was in a winter semester (2013). This would allow the students from the three faculties to have the necessary in class instruction, clinical experience and consequently the necessary knowledge to take part in the simulated scenario.

Unfortunately, despite an extended recruitment phase, the of work of the RAs to stimulate interest in the study and the added incentives to participate, scheduling difficulties and other class commitments made it impossible to work out an appropriate time when all three students groups were available. The pharmacy students were not available at the times when the nursing and medical students were available. Therefore, only medical and nursing students were able to participate in the research.

The RAs from nursing and medicine recruited their classmates through Facebook© and by making contact in person during class and clinical time. Potential participants, who met the inclusion criteria, were assigned a convenient time to arrive at the simulator laboratory and meet the researcher. The times assigned to the students were during regular operating hours for the simulation laboratory faculty at Memorial University which was 0830 -1630 Monday to Friday. Students were recruited during the winter semester, 2013 and participated during free time in their schedules. A total of 30 students were recruited, 10 from medicine and 20 from nursing, and they comprised the 10 teams for the simulated clinical experiences (two nursing and one medical student per team).

Setting

The HF- SICE took place in the Human Patient Simulator (HPS) Laboratory located at Memorial University of Newfoundland, Faculty of Medicine. The laboratory contains the high fidelity human patient simulator (HPS) manufactured by Medical Education Technologies Inc. (METI). This HPS is a high-fidelity mannequin and is the physical size of a standard male patient. The mannequin is able to manifest the signs and symptoms of a variety of human illnesses and disease processes. He responds in real time to drugs administered and many technical medical procedures can be performed, for example endotracheal intubation, chest tube insertion, insertion of nasogastric tubes and urinary catheters to name a few.

The simulator laboratory was set up to resemble a standard patient room in the hospital setting. Students were required to wear their clinical dress, this helped to foster the realism of the simulation and help students become “encultured” into the simulation experience.

Procedure

Potential participants were given a very brief overview of the simulation experience and the study by the RA. The RA assigned those interested in participating in the study a convenient date and time for their HF-SICE. On the day of their HF-SICE students came to the simulation laboratory dressed in their professional clothing. The nursing students wore their uniforms and the medical students wore either operating room greens or lab coats over their business clothing.

At their assigned times the team of three students, two from nursing and one from medicine, gathered in the debriefing room and were met there by the researcher. In the first few minutes the researcher answered questions posed by the potential participants, clarified any misunderstandings and outlined the objectives of the study. Any further questions were addressed and then the students were asked if they wished to participate in the study. If they agreed, they were then asked to sign the consent form (see Appendix G). In signing the consent, students were made aware that the simulation was being videotaped for future review and analysis. Students were assured that there would be no academic prejudice should they decide not to participate and that they could withdraw at anytime during the HF-SICE. Following signing the consent the students were then asked to complete the Demographic form (see Appendix H), the Attitudes Towards Interprofessional Education (ATIPE) questionnaire (see Appendix I) and the Attitudes Towards Interprofessional Healthcare Teams (ATIPHCT) questionnaire (see Appendix J).

Once these pre-test questionnaires were completed the students were taken into the simulation laboratory. Here, the co-coordinator of the simulation laboratory gave the participants an orientation to the high fidelity mannequin, as well as to the simulation room. This room was organized to resemble a typical patient room on any inpatient ward in a hospital setting. The students were shown where the supplies were kept should they require them during their simulation experience. Once the orientation was completed and all questions were answered, the researcher gave the students the case for their simulation. The students were told they were the team making rounds in the morning and they assumed the role of their respective profession. They were given a change-of-shift report by the researcher on their patient who we called, John Thomas Smith. The report included any pertinent data the students may require in assuming care for this patient. They were given a patient chart, with all the history they might require, as well as access to reference materials in the room and pertinent agency policies that they may want to review.

The researcher remained in the room but stepped to the side, the video camera was turned on and the team assumed care for their patient. The researcher chose to stay in the room in order to provide “clues”, if required during the simulation. As noted by Jefferies (2007) these “clues” help to keep the student progressing and to help them overcome any hurdles, without interfering with their individual problem solving. The simulations lasted anywhere from 10:00-14:00 minutes in duration. This varied depending on the team’s decision making and the time it took for them to implement their care decisions. All 10 simulations ended with a stable patient. Jefferies (2007) recommends that simulation faculty should avoid catastrophic outcomes unless the objectives of the simulation specifically call for this. Otherwise scenarios should end with a viable patient.

Simulation Scenario

The objectives and details of the clinical scenario were developed by the researcher in consultation with faculty members of the disciplines initially involved in the project (i.e. nursing, medicine, and pharmacy) (see Appendix K). This was to ensure that students had the appropriate level of knowledge and skills to make care decisions for this particular simulated patient, while making the experience challenging.

The simulation scenario involved a clinical situation where a 78-year-old male, Mr. John Thomas Smith, was admitted to the general surgery floor overnight for observation. He had presented to the Emergency Department with history of a fall, left upper quadrant abdominal pain and bruising. He resides in an assisted living complex, and has a history of coronary artery disease (CAD), non-insulin dependent diabetes (NIDDM), peripheral vascular disease (PVD), gastroesophageal reflux disease (GERD), and gout. He is taking several medications for his medical conditions. The medication list was given to the students (Appendix L).

During morning rounds the patient complains of shortness of breath (SOB), and feeling light headed. His vital signs have deteriorated and his morning blood work reveals haemoglobin (Hgb) of 58 g/L and his International Normalised Ratio (INR) is 9.8. The "student team" assumes the care for this patient whose deteriorating condition requires a collaborative team approach for optimal management of his care. The team members were able to request additional tests such as blood work or radiographic studies, as well as administer any drugs they felt were feasible to treat the patient's condition.

Debriefing

Debriefing fosters reflective learning, enhances critical thinking and helps the student process the simulation experience (Mariani et al., 2013). Kuiper and colleagues (2008) believe that structured debriefing can help foster a culture of safety amongst professionals. Thus, immediately following the HF-SICE participants were taken to the debriefing room. The researcher led the session using the objectives to keep the discussion focused. The conversation centered on how they felt about the experience, what they felt went well, what went wrong, and what they would like to have done differently. The videotape of the team's experience was reviewed and paused at different intervals to allow for participants to comment and elaborate on what was happening at that particular point in time. The debriefing sessions encouraged students to reflect upon their interprofessional collaboration experience with the purpose that they will gain insight into the roles and responsibilities of the various team members. Reflection also helps the individual team member to appreciate the importance of the knowledge and skills that each professional brings to the healthcare team setting.

During the debriefing the researcher was cognizant of creating an atmosphere where the participants felt comfortable and relaxed; thereby making them feel it was safe to critique themselves and the other members of the team.

The total experience took approximately 60 minutes. This is in keeping with the simulation conceptual framework as outlined by Jefferies (2007), where she supports the pre-brief, simulation and debriefing being 20 minutes - 10 minutes - 20 minutes respectively followed by 10 minutes for completion of the post-questionnaires. The post questionnaires included the same ATIPHCE and ATIPHCT that were completed prior to the simulation as well as a Satisfaction Questionnaire and 4 open-ended questions.

Data Collection Instruments

These pre-questionnaires were completed once the students had signed their consent to participate in the research study and the post-questionnaires were completed immediately following the debriefing.

Participant demographic and descriptive information. The demographic form developed by the researcher included; age, gender, discipline, academic year of study, previous interprofessional (IP) experience and previous simulation experience (see Appendix H).

Attitudes towards interprofessional healthcare teams (ATIPHCT) tool. The ATIPHCT tool is based on an instrument originally developed by Heinmann, Schmitt, Farrell, & Brallier (1999) (as cited in Heinmann & Zeiss, 2002) and adapted by Curran et al., (2008) (see Appendix J). This measure has been used successfully as a pre/post test instrument in evaluating interventions with teams (Heinmann, Schmitt, Farrell, & Brallier 1999). This tool consists of 14 five-point Likert scale items (1 = strongly disagree to 5 = strongly agree) and compares the attitudes of the different disciplines towards interprofessional teams. The total range of possible scores is 14 – 70 with higher scores indicating a more positive attitude towards interprofessional teams. This tool has been reported to have strong internal consistency with a reported Cronbach`s alpha = .83 (Heinmann & Zeiss, 2002); and .88 (Curran, Sharpe & Forrestal, 2008). Construct validity for this tool was confirmed by Brown and Chamberlain (1996) who used this tool to assess the attitudes of nurses, physicians, social workers and pharmacists towards interprofessional teams and replicated by Heinemann and colleagues (1999). Content validity has also been established for this tool with a content validity index of .95 (Heinmann & Zeiss, 2002). As outlined this is a robust tool for measuring attitudes toward healthcare teams as indicated by the psychometric data, and consequently it was used for this research study.

Attitudes towards interprofessional education (ATIPE) tool. The ATIPE tool is adapted from Parsell and Bligh (1999b) and was based on the Readiness for Interprofessional Learning Instruments developed by these authors (Appendix I). This tool consists of 15 five-point Likert scale items (1 = strongly disagree to 5 = strongly agree) that compares how participants from each of the disciplines feel about interprofessional education. The total range of possible scores is 15 - 75 with higher scores indicating a more positive attitude towards interprofessional education. It has a reported internal consistency of Cronbach’s alpha = .90

(Curran et al., 2010) and .92 (Curran, Sharpe & Forrestal, 2008). This tool has been used extensively in studies measuring the attitudes of undergraduate students towards interprofessional education (Horsburgh, Lamdin, & Williamson, 2001; Morison, Boohan, Moutray, & Jenkins, 2004; Reid, Bruce, & McLernon, 2006; Scherer et al., 2013).

Satisfaction survey. At the end of the HF-SICE students also completed a Satisfaction Survey developed by Curran et al. (2010). This tool was used to assess the overall satisfaction of students with their interprofessional experience. This survey was used with permission and modified slightly to reflect the simulation experience (see Appendix M). It is comprised of 10 five-point Likert scale items (1 = strongly disagree to 5 = strongly agree) with possible scores ranging from 10 - 50. Higher scores indicate the participant's greater level of satisfaction with the simulation experience. Students were asked to rate their level of satisfaction with the extent to which the experience enhanced their knowledge and understanding of the subject area, interprofessional teamwork, their role and the role of other team members as well as the organization and design of the simulation experience. Curran et al. (2010) reported a Cronbach's alpha = .92 for this satisfaction survey.

Open-ended questions. To capture how the students felt about the overall experience, they were invited to answer four open-ended questions developed by the researcher:

1. What did you like about the simulated interprofessional experience?
2. What would you change or improve?
3. What did you learn about interprofessional collaboration and teamwork?
4. Any other comments?

Communication and teamwork skills tool (CATS). With permission from the participants, the simulated scenarios were videotaped and analyzed for teamwork and communication behaviours using the Communication and Teamwork Skills (CATS) assessment tool (Frankel, Gardner, Maynard, & Kelly, 2007) (see Appendix N). This assessment tool was developed to assess teamwork skills in any of the healthcare professions. While interprofessional collaboration and teamwork are valued in today's healthcare setting and are becoming core educational requirements, there is a scarcity of validated and reliable tools to measure these competencies in pre-licensure students (Baker, Pulling, McGraw, Dagnone, Hopkins-Rosseel & Medves, 2008; Frankel, 2007; Wright, Phillips-Bute, Petruse, Griffin, Hobbs, & Taekman, 2009). Consequently, researchers, patient safety administrators and educators alike are striving to devise a means to assess, monitor and improve teamwork skills (Frankel et al., 2007). Some of the tools currently available include:

- Observational Teamwork Assessment of Surgery (OTAS) tool, Healey, Undre, & Vincent, (2004) measures surgical team performance and assess what these teams do and how they do it.
- Clinical Teamwork Scale (CTS) tool developed by Guise et al. (2008) measures the teamwork skills of already practicing healthcare clinicians.
- Anaesthesiologist Non-Technical Skills (ANTS) tool by Flin and Maran (2004) evaluates individual members or whole teams of anaesthesiologists.
- Behaviourally Anchored Teamwork Skills (BATS) tool by Wright et al. (2009) assesses uniprofessional medical teams.

This is not an all-inclusive list but these tools have all been validated and have been used most frequently with either uniprofessional, post-graduate teams or practicing healthcare interprofessional teams. All of these tools are closely aligned, sharing the common fundamental teamwork behaviours. However, these tools were developed to measure teamwork behaviours for a specific discipline or post graduate teams and not necessarily pre-licensure students as in the case of this study.

In contrast the CATS tool developed by Frankel et al. (2007) assesses the same four team behaviours as these other tools but it is intended to be applicable across the different healthcare professions. The four main team behaviour domains that are assessed in the CATS tool are: coordination, situational awareness, cooperation and communication all of which are considered essential behaviours for cohesive team performance (Flin & Maran, 2004; Healey, Under, Vincent, 2004; Wright et al., 2009).These four domains are further subdivided into various behaviors: within the domain of coordination the following behaviors are observed for and graded: briefing, verbalizing plan, verbalizing expected timeframes and debriefing. Within the domain of situational awareness the behaviors of: visually scan the environment and verbalizes adjustment in plan as changes occur are observed for and graded, within the domain of cooperation the behaviors of: request external resources if needed, ask for help from team members as needed, verbally request team input, cross monitoring verbal assertion and receptive to verbal assertion are observed for and graded, and within the domain of communication the behaviors of: closed-loop, situation, background, assessment and recommendation (SBAR), verbal updates , uses names, communicate with patient and appropriate of voice are observed for and graded. This tool is intended to evaluate the entire team's performance and not the individual's performance.

Frankel et al. (2007) did not outline an ultimate or a best score for the tool but stated that higher scores would indicate better team performance as opposed to the teams with lower scores, which would indicate the need for further instruction and practice in teamwork activities. The authors of the tool did not provide any data regarding psychometric properties of the instruments but they did acknowledge that further testing of the tool is required. Because the CATS tool was developed for interprofessional teamwork it was thought to be the most appropriate tool for this study.

Sample Size and Data Analysis

While a larger sample size for this pilot study was anticipated, a total of 30 students were recruited to participate in this study, 10 from the Faculty of Medicine and 20 from the School of Nursing. A calculated sample size was not indicated, as this is a pilot project assessing the potential for high-fidelity simulation to be utilized as an additional teaching modality to enhance interprofessional learning and teamwork amongst pre-licensure healthcare students.

The Statistical Package for Social Sciences (SPSS 20.0) was used for the quantitative data analyses in this study. Data were initially coded and entered into the data file by the researcher. The data were subsequently cleaned to detect any errors or omissions. Descriptive statistics were used to generate data for the age, gender, program of study and previous interprofessional experiences as well as previous simulation experiences of the participants. Internal consistency reliability of the study instruments was conducted using Cronbach's alpha, a commonly used indicator that is a dependable test for determining the internal consistency of a tool (Polit & Beck, 2008). Independent t-tests were used to detect differences between the nursing and medical students, as to their attitudes towards IPE and IP teams before HF-SICE and after HF-SICE. Paired t-tests were used to detect a change in the entire sample's attitudes towards IPE and IP teams, pre HF-SICE and as compared to their attitudes following their participation in a HF-SICE. Mean scores were calculated for the satisfaction survey to determine the students' overall satisfaction with the HF-SICE. Differences in satisfaction between the nursing and medical students were also analyzed using an independent t-test.

To verify the parametric results and because of the small sample size (n=30) of this pilot project, it is recommended that the comparable non-parametric test be conducted (Pett, 1997). Therefore the Mann-Whitney U test, which is the non-parametric counterpart of the independent t-test, was conducted to compare the medians between the medical and nursing students as to their attitudes towards IPE and IP teams before HF-SICE and after HF-SICE. The non-parametric counterpart for the paired t-test, the Wilcoxon Signed Rank test was used to compare the median rank scores of the entire sample's attitudes towards IPE and IP teams, pre HF-SICE as compared to their attitudes following participation in a HF-SICE.

Two observers utilized the CATS tool to assess the videotapes for demonstration of teamwork behaviours for each of the 10 simulated experiences. The score sheets for the CATS tool are divided into three columns: "observed and good", "variation in quality" and "expected but not observed" for each of the 4 main behaviours of coordination, situational awareness, cooperation and communication (see Appendix N). These four main behaviour categories are further sub-divided into more specific behaviours for the observers to score. The observer marks or ticks each time the teamwork behaviour occurs and grades the quality of the behaviour. Marks in the "observed and good" column received a score of 1, marks in the "variation in quality" receive a score of 0.5, and marks in the expected but not observed receive a score of 0. The scores are added to give a weighted total. A second total is obtained by simply adding the total number of marks in each column. The weighted total divided by the total number of marks give a decimal value and multiplied by 100 yields a percentage value for the behaviour.

The two observers involved in the analysis of the CATS tool were current clinical faculty at Memorial University of Newfoundland School of Nursing and have greater than 23 years of acute care nursing experience each. They have extensive experiences in intensive care, cardiac care, surgical and emergency nursing. These two faculty members reviewed the videotapes independently and scored the demonstrated teamwork behaviours for each of the 10 teams.

Prior to reviewing the HF-SICE tapes the two observers met with the researcher and discussed the Communication and Teamwork Skills (CATS) tool. The definitions of the behaviours that were being analyzed were discussed to ensure that the two observers were consistent in their scoring. A pilot tape of a HF-SICE was then viewed by the two observers with the researcher; this tape was not included in the data collection for the study but used as a teaching tool for the two observers. The pilot tape was reviewed and paused throughout to enable discussion amongst the viewers. This was to ensure consistency of the scoring of the CATS tool. Following this information session each faculty member took the tapes and individually watched and graded them for the behaviours of teamwork and communication as outlined by the CATS tool. Once the two viewers had scored the videos and submitted their grading sheets to the researcher, the scores were entered into the SPSS package for statistical analysis. Inter rater reliability of the CATS tool was determined using the Intraclass Correlation Coefficient (ICC). The ICC is a reliable index used to demonstrate the strength of the relationships between the scores of the two raters (Polit & Beck, 2008).

The responses to the open - ended questions were reviewed for content analysis by the researcher to identify common themes emerging from the responses of the participants. Thematic analysis (Braun & Clarke, 2006) is a method for analysing and identifying common themes within a data set. This method of analysis involves transcribing the data into a table and producing codes that are features of the data that are of interest to the researcher. Once all the responses to the questions were coded, the researcher then refocused the analysis to the broader level of identifying themes that are emerging from the codes. The themes were then reviewed, the most common ones extracted and named. The identified themes for each of the four questions were put into tables along with the number of times they appeared in the data set. The researcher coded and identified themes emerging from the data set that were pertinent to the study and the research questions.

Ethical Considerations

Ethical approval was obtained from the Interdisciplinary Committee on Ethics in Human Research (ICEHR), at Memorial University of Newfoundland.

Participation in the study was strictly voluntary and written informed consent was obtained from each participant prior to participating in the research (see Appendices G). Informed consent implies that the purpose of the research and how the research findings will be reported was explained to each participant. The researcher did not foresee any risk to the participant in taking part in the study. The potential benefit of participation may be an increase in knowledge and a more positive attitude towards interprofessional teamwork and collaboration.

The participants were guaranteed anonymity; neither their name, nor any identifiable information appears on any of the research materials. All videotapes, questionnaires and forms pertaining to the research project, as well as the research findings are kept in a locked drawer of the researcher’s office for 5 years and only the primary researcher has access to the locked drawer.

Chapter 4: Data Analysis

The findings of this study are presented in this chapter. Parametric and non-parametric tests were performed to address the research questions. The Statistical Package for Social Sciences (SPSS) 20.0 was used for data analysis and statistical tests were performed using the significance level $p \leq .05$. First the descriptive characteristics of the study participants will be described. Secondly the statistical analysis of the study instruments and the findings as they relate to the research questions will be reported. Finally the findings of the Communication and Teamwork Skills (CATS) assessment tool as well as the themes emerging from the open-ended questions will also be presented.

Descriptive Profile of the Participants

There were a total of 179 potential participants to be recruited to take part in this study, 65 medical students and 114 nursing students. In the end a total of thirty (n = 30) students participated in this study; nine of the students were in their third or fourth year of the Bachelor of Nursing (BN) (regular stream option), 11 were in their second year of the Bachelor of Nursing (BN) (fast- track option) and 10 were in their third year of the degree of Doctor of Medicine program. Five of the participants were male and 25 female. The ages ranged from 21-35 years, with the average age of participants being 25.23 years. Twenty-six of the participants had previous simulation experience and 24 participants reported previous interprofessional education (IPE) experience. All participants signed the consent to participate in the study and agreed to be videotaped during the high-fidelity simulated interprofessional clinical experience (HF-SICE). Participation was strictly voluntary and none of the students withdrew from the study. Table 4.1 outlines the descriptive details of the participants.

Table 4.1
Descriptive Characteristics

Professional Program	Gender (n = 30)			Previous Simulation Experience (n = 26)		Previous Interprofessional Experience (n = 24)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Nursing FT	Male	1	3				
	Female	10	33	9	35	11	46
Nursing RS	Male	1	3				
	Female	8	27	7	27	3	13
Medicine	Male	3	33				
	Female	7	23	10	33	10	33

Nursing FT: 2 year fast track program; Nursing RS: 4 year regular stream program

Reliability Analysis

Reliability was assessed using Cronbach's alpha coefficient, which measures the internal consistency of the data obtained with the three study instruments: Attitudes Towards Interprofessional Healthcare Teams, Attitudes Towards Interprofessional Education and Satisfaction Survey. Internal consistency reliabilities for the three data collection instruments are presented in Table 4.2. The coefficients ranged from .746 to .906, which were all considered acceptable. According to Pallant (2010), values of .7 and above are considered acceptable however values above .8 are more preferable. The instruments used for this study were developed by Curran et al. (2010) and used with permission from the author. Other research has previously reported reliability coefficients of .8 and above for these tools.

Table 4.2
Reliability analysis of internal consistency using Cronbach's Alpha coefficient for the study instruments (n = 30)

Instrument	Cronbach's Alpha
ATIHCT*	$T_1 = .746$ $T_2 = .846$
ATIPE**	$T_1 = .836$ $T_2 = .906$
Satisfaction Survey	$T_2 = .843$

*ATIHT- Attitudes Towards Interprofessional Healthcare Teams; **ATIPE- Attitudes Towards Interprofessional Education

Data Collection Instruments

Attitudes towards interprofessional healthcare teams tool (ATIHCT). To address the first research question as to whether participation in a HF-SICE promotes a positive change in attitudes towards interprofessional teams it was necessary to determine if there were any differences in the student's attitudes at baseline (T1). An independent t-test was used to compare the means of the medical students to that of the nursing students prior to participating in the HF-SICE. The following results were obtained T1 M = 53.5 (SD = 4.06) for medicine and T1 M = 51.9 (SD = 2.38) for nursing at baseline. As shown in table 4.2 no statistically significant differences were found between the two groups at pre-test (T1) with respect to their attitudes towards interprofessional healthcare teams ($t = 1.37$, $p = .183$). Therefore any change in the students attitudes following the HF-SICE can most likely be attributed to participation in the HF-SICE itself. It was also determined that there were no statistically significant differences in the mean scores of the nursing as compared to the medicine students at T2 ($t = 0.507$. $p = .616$).

A paired t-test was then used to determine if there were statistically significant differences in the mean scores of the students following the HF-SICE (T2) as compared to the mean scores at baseline (T1). Results indicated that students reported a statistically significant positive change in their attitudes towards interprofessional healthcare teams following their HF-SICE ($t = -10.79$, $p = .000$).). The two groups demonstrated equally positive changes in their attitudes towards interprofessional healthcare teams. See Table 4.3

Table 4.3
Attitudes Towards Interprofessional Healthcare Teams (ATIHCT)

Independent t-test Pre (T 1) and Post (T 2) ATIHCT

Variable	Mean	SD	CI 95%	p	t
Time 1	Nursing 51.9 n = 20	2.38	[-0.80, 4.0]	.183	1.37
	Medicine 53.5 n = 10	4.06			
Time 2	Nursing 60.9	4.40	[-2.89, 4.79]	.616	0.507
	Medicine 61.8	5.65			

Paired t-test Pre (T 1) and Post (T 2) ATIHCT

Variable	Mean (n = 30)	SD	CI 95%	p	t
Time 1	52.43	3.07	[-10.39, -7.08]	.000	-10.79
Time 2	61.17	4.78			

Attitudes towards interprofessional education tool (ATIPE). To address the second research question as to whether there was a positive change in student attitudes towards interprofessional education following participation in a HF-SICE it was again necessary to determine if the students were the same at baseline (T1). An independent t-test was used to compare the mean scores of the medical students to that of the nursing students in terms of their attitudes towards interprofessional education at baseline prior to participating in the HF-SICE. The following results were determined M = 64.7 (SD = 5.77) for nursing and M = 64.9 (SD = 5.06) for medicine at baseline (T1). It was determined that there were no statistically significant differences in the mean scores of these two groups of students at pre-test (T1) with respect to their attitudes towards interprofessional healthcare education (t = -.122. p = .904). Therefore any change in the students attitudes following the HF-SICE can most likely be attributed to participation in the HF-SICE itself. It was also determined that there were no statistically significant differences in the mean scores of nursing as compared to medicine students at T2 M = 67.8 (SD = 6.16) for medicine and M = 68.35 (SD = 5.41) for nursing (t= -.251, p = .251).

A paired t-test was then used to determine if there were statistically significant differences in the mean scores of the students following the HF-SICE (T2) as compared to the mean scores at baseline (T1). Results indicated that students reported a statistically significant positive change in their attitudes towards interprofessional education following their HF-SICE (t = -4.28, p = .000). Both groups demonstrated equally positive changes in their attitudes toward interprofessional education (See Table 4.4).

Table 4.4
Attitudes Towards Interprofessional Education

Independent t-test Pre (T 1) and Post (T 2) ATIPE

Variable	Mean	SD	CI 95%	p	t
Time 1	Nursing 64.95 n = 20	5.06	[-0.46, 3.96]	.904	-0.122
	Medicine 64.70 n = 10	5.77			
Time 2	Nursing 68.35	5.41	[-5.04, 3.94]	.804	-0.251
	Medicine 67.80	6.16			

Paired t-test Pre (T 1) and Post (T 2) ATIPE

Variable	Mean (n = 30)	SD	CI 95%	p	t
Time 1	64.87	5.21	[-4.88, -1.72]	.000	-4.28
Time 2	68.17	5.57			

Non-parametric test results. Given the small sample size, it was determined that comparable but more conservative non-parametric tests would also be conducted to verify the results of the parametric tests. The Mann Whitney U is the comparable non-parametric test for the independent t-test. According to Pett (1997) the Mann Whitney U is the most commonly used non-parametric test in healthcare research to compare the means within a group. A Mann-Whitney U test was used to evaluate the differences in the attitudes of the medical and nursing students towards interprofessional healthcare teams (ATIHCT) and interprofessional education (ATIPE) at baseline and following the HF-SICE. No statistically significant differences were found.

The Wilcoxon Signed rank test, which is the non-parametric alternative to the paired t-test, was used to determine if there was a significant difference in the median scores of the group with respect to their attitudes towards interprofessional teams (ATIHCT) and interprofessional education (ATIPE) prior to participating in a HF-SICE (T1) and immediately following the experience (T2). Please refer to Table 4.5 and 4.6 for the non-parametric results.

Table 4.5
Non-Parametric Tests: Mann Whitney U for ATIHCT

	U (n = 30)	Z (n = 30)	p
Time 1	74.00	-1.15	.249
Time 2	96.50	-0.155	.877

Non-Parametric Tests: Wilcoxon–Signed Ranks for ATIHCT

	Z (n = 30)	p
Pre/Post Test	-4.69	.000

Table 4.6
Non-Parametric Tests: Mann Whitney U for ATIPE

	U (n = 30)	Z (n = 30)	p
Time 1	98.00	-0.88	.930
Time 2	97.50	-0.111	.912

Non-Parametric Tests: Wilcoxon–Signed Ranks for ATIPE

	Z (n = 30)	p
Pre/Post Test	-3.82	.000

The non-parametric test results support the findings of the parametric t-tests. There were no statistically significant differences between the nursing and medical students at baseline in terms of their attitudes towards interprofessional education and interprofessional healthcare teams. However statistically significant positive differences were found in their attitudes following participation in a HF-SICE.

Satisfaction survey. The Satisfaction Survey was completed by the participants immediately following the debriefing session. Participants had an overall mean score of M= 56.10 (SD = 3.59) with scores ranging from 48 – 60 out of a possible score of 60 (see Table 4.7). There were minimal differences in the mean scores for the two disciplines with a reported mean M = 55.70 (SD = 4.06) for nursing and a mean M = 57.00 (SD = 2.17) for medicine. A t-test revealed there were no statistically significant differences between the groups (see Table 4.8). It can be inferred that the overall satisfaction with the HF-SICE was moderate to high amongst all participants from both disciplines.

Table 4.7
Satisfaction Survey

# items	*M(n=30)*	*SD*	Range: Potential	Range: Actual
12	56.10	±3. 59	14-60	48-60

Table 4.8
t- test Satisfaction Survey

Professional Program	Mean	SD	t	p
Nursing (n = 20)	55.70	4.06	0.897	.378
Medicine (n = 10)	57.00	2.17		

Communication and teamwork assessment skills tool (CATS). To answer the third research question as to whether the students demonstrated teamwork behaviors during their HF-SICEs, the scenarios were videotaped and reviewed by two trained faculty members from Memorial University School of Nursing. The videos were reviewed and scored individually to evaluate communication and teamwork skills demonstrated by the students during the HF-SICE. These two faculty members have strong acute care clinical backgrounds and have participated in previous interprofessional education and research as well as high-fidelity simulation projects in the past. The rating for the 5 main categories: coordination, situational awareness, cooperation, communication, crisis situation and totals are provided in Table 4.9 for rater 1 and rater 2.

In evaluating the 10 videotapes it was determined that all 10 teams demonstrated some if not all of the behaviours of teamwork and communication at some point during the experience. However there was a range to how often these behaviours were demonstrated during the 20 minute experience. The individual team scores on the CATS tool ranged from the highest score of 89 and the lowest score of 49. The authors of the tool (Frankel et al., 2007) did not outline a "best possible score", but rather suggested that the higher the score, the better the team was in performing the behaviours believed to facilitate teamwork and communication amongst healthcare providers. This would indicate the opposite being true for the teams with the lower scores, where these teams showed evidence of a deficiency in the behaviours that are considered essential for maximum team performance. Frankel et al. (2007) suggest that educators and administrators could use the team scores to establish which teams are lacking the necessary teamwork behaviours and need improvement. These teams require more education and more practice to perfect these essential skills.

The intraclass correlation coefficient (ICC) was used to determine interrater reliability of the CATS tool. This statistical test determines the consistency of the quantitative measures made by the two observers viewing the simulation scenarios and coding with the CATS tool. The ICC was determined to be .728. Coefficients in the vicinity of .7 are considered adequate, however a higher ICC would be more desirable (Polit & Beck, 2008). Chinn (1991) stated that an ICC higher than .6 is required to determine if an instrument is useful. It was determined that the ICC amongst the observers in this research study was adequate.

As expected there are differences in the team ratings of the CATS tool between the scorers. Scores of the two raters were within 10 points of each other for seven of the teams, and within five points for five teams. Overall the two raters were generally consistent in identifying the teams that were performing better than those teams who were deficient in teamwork and communication skills. The two observers were in agreement as to which was the top performing team (team 3), as well as agreeing on the two teams who performed the worst in demonstrating teamwork behaviours (team 4 and team 9).

Table 4.9
Communication and Teamwork Skills Tool (CATS)

	Team 1		Team 2		Team 3		Team 4		Team 5	
Behaviors	R1*	R2*	R1	R2	R1	R2	R1	R2	R1	R2
Coordination	10	13	14	15	13	12	9	5	7	12
Situational Awareness	7	11	10	11	8	14	7	9	5	11
Cooperation	26	25	21	23	25	31	18	17	19	32
Communication	28	27	32	21	38	27	20	14	23	26
Crisis Situation	4	8	3	8	5	5	2	4	3	4
Total	75	84	80	78	89	89	56	49	57	85

	Team 6		Team 7		Team 8		Team 9		Team 10	
Behaviors	R1	R2	R1	R2	R1	R2	R1	R2	R1	R2
Coordination	9	13	5	13	6	9	4	8	5	8
Situational Awareness	8	12	7	10	4	9	6	6	7	12
Cooperation	25	23	19	19	25	20	16	17	15	29
Communication	33	23	25	13	22	15	23	18	31	25
Crisis Situation	1	4	3	8	3	5	0	5	2	4
Total	76	75	59	63	60	76	49	54	60	78

*R1: Rater one, *R2: Rater two

Open-ended questions. To ascertain how the participants felt about the experience they were also asked to complete four open-ended questions. Students were asked to comment on the following:

1. What did you like about the simulated interprofessional experience?
2. What would you change or improve?
3. What did you learn about interprofessional collaboration and teamwork?
4. Other comments?

All students (n = 30) completed the first three questions but only 11 (33%) had additional comments. The responses were reviewed and analyzed individually by the researcher using thematic analysis (Braun & Clarke, 2006) which is a method for analysing and identifying common themes within a data set (see page 73 for more detail about the analysis). See Table 4.10 for themes, illustrative quotes, and the number of times they were noted by the students.

Three main themes emerged from the responses to the question “What did you like about the simulated interprofessional experience?” These themes were: teamwork, interprofessional awareness and safe environment with the most common theme being interprofessional awareness. Students felt they had a better understanding of the role of other team members following their participation in the HF-SICE.

The most two common themes that emerged from the responses to the question, “What would you change or improve?” were: longer HF-SICEs and more frequent SICEs. These responses indicate that students enjoyed the experience, found it helpful and would like to see more HF-SICEs incorporated into their undergraduate curriculum.

The most common three themes that emerged from the responses to the question “What did you learn about interprofessional collaboration and teamwork was: unique body of knowledge, communication important, interprofessional education is vital. The experience gave students a better understanding of the importance of communication for effective teamwork as well as providing more insight about the knowledge that each discipline brings to the team.

Only 11 students had additional comments to make in question four, all 11 (100%) of these students added the comment that it was a great experience.

Table: 4.10
Open-Ended Questions

Question	Themes and Illustrative Quotes	Number of Occurrences
1.What did you like about the HF-SICE (n = 30)	·Teamwork “feeling like a valued member of the team”	4
	·Interprofessional Awareness “gave me the opportunity to work with other disciplines”	12
	·Safe Environment “allowed to make mistakes without being stopped, no risk of harm to patient”	5
2. What would you change or improve? (n = 30)	·Longer HF–SICE’s “more time in the simulator”	4
	·More frequent HF–SICE’s “do it more often”	12
3. What did you learn about Interprofessional collaboration & teamwork? (n = 30)	·Unique body of knowledge “I learned no one profession is an expert on everything”	9
	·Communication importance “communication is key to IP collaboration and teamwork”	6
	·It is vital “simulation is extremely valuable for students entering the work force”	3
4. Other Comments (n = 11)	·Great experience “really awesome experience”	11

Summary

A total of 30 pre-licensure students participated in this study, 10 from medicine, and 20 from nursing. Five were male and 25 were female, with a mean age of 25 years. Eighty seven per cent of the students had previous simulation experience and 80 % reported previous interprofessional education experience.

There were no statistically significant differences between the nursing and medical students at baseline in regards to their attitudes towards interprofessional education and attitudes towards interprofessional healthcare teams. Statistically significant positive differences were found for the group as a whole following their participation in a HF-SICE as compared to the mean scores prior to participation in a HF-SICE. The entire cohort (n = 30) reported more positive attitudes towards interprofessional education and interprofessional teams following participation in a HF-SICE. This answers the research questions posed at the beginning of this study regarding if students will report positive changes in their attitudes towards IPE and IP teams following participation in a High-Fidelity Simulated Interprofessional Clinical Experience (HF-SICE).

To answer the research question if students will report high levels of satisfaction following participation in a HF-SICE the results from the post satisfaction questionnaire were positive in reporting that students were highly satisfied with the experience.

The final question to be addressed in this study was does participation in a HF-SICE facilitate collaboration and teamwork in pre-licensure health sciences students? This question was answered by reviewing the videotapes of the HF-SICE and assessing teamwork performance and communication of the 10 student teams. The two independent raters agreed that this venue is a plausible arena for the teaching and learning of the teamwork and communication behaviors coveted by healthcare agencies and required by healthcare providers.

Chapter 5: Discussion

This chapter will discuss the research findings in relation to the research questions outlined at the outset of the study. Findings are compared and contrasted to the existing literature where applicable. The chapter will also discuss the study limitations as well as the implications and recommendations for interprofessional health sciences education, research and practice.

In today's healthcare setting new graduates from nursing and medicine are often faced with the challenge of caring for complex patients in acute clinical settings. These situations require new graduates to collaborate with other members of the team to apply their knowledge and skills when coordinating care of the patient. This interprofessional collaboration is an important and requisite skill when caring for the acutely ill and it must be taught, supported and nurtured in pre-licensure healthcare education programs (Gallagher et al., 2010; Robertson & Bandali, 2008). Unfortunately, new graduates from nursing and medicine often enter the workforce with very little experience in collaborating with other members of the healthcare team (Robertson & Bandali, 2008).

A team approach is required in today's healthcare system to maximize patient safety and minimize errors. Although interprofessional education programs can help to cultivate team performance, healthcare professionals have traditionally been educated in isolation with little knowledge of the roles and responsibilities of the other team members (Reese, Jefferies & Engum, 2010; Robertson et al., 2010; Schuetz, Mann & Everett, 2010). One healthcare professional alone cannot meet the healthcare needs of today's complex patients. An emerging innovative approach for educating pre-licensure health sciences students is the use of high-fidelity human patient simulation (HF-HPS) learning experiences.

While the evidence to support the use of High-Fidelity Simulated Interprofessional Clinical Experiences (HF-SICEs) as a teaching tool for pre-licensure healthcare students is growing, more research is required to establish the most appropriate ways to use HF-SICEs for teaching interprofessional healthcare skills. This pilot study was conducted to explore the feasibility of using HF-SICEs to facilitate teamwork and communication in pre-licensure nursing and medical students. It was the intent to include pharmacy students in the research however due to scheduling conflicts it was impossible to find a suitable time where all three groups of students could take part in the simulation experience. Consequently only nursing and medical students participated. Two of the research questions were to evaluate whether or not students reported positive changes in their attitudes towards interprofessional education and in their attitudes towards interprofessional teams following participation in a HF-SICE. Overall team performance was also evaluated by two independent raters using the Communication and Teamwork Skills tool (CATS). Each of the 10 videotaped team simulations were evaluated for the five behaviors of the CATS tool which included: coordination, situational awareness, cooperation, communication, and crisis situation. The raters marked and graded each time these behaviors were demonstrated by any member of the team and the final overall team performance scores were tabulated. This addressed the third research question which was to find if HF-SICEs were feasible environments for students to practice teamwork and communication skills.

The theory of situated cognition along with the Nursing Education Simulation Framework (NESF) (Jefferies, 2007) was used to guide the study. This theory posits that participants come to the HF-SICE with pre-existing attitudes towards interprofessional education and interprofessional teams, as well as their own knowledge and skill set. For learning to occur during a HF-SICE, situated cognition proposes that knowledge is being accumulated through all the senses. This is accomplished as students are fully immersed in the situation, interacting with the simulated patients, and collaborating with the team member to make care decisions. This provides them with a valuable learning experience in a safe environment without the potential of causing harm to the patient.

Demographic Characteristics and Previous Interprofessional Education Experience

The average age of the 30 student participants in this study was 25 years and ranged from 21 to 35 years. The 20 nursing student participants were from either the third or fourth year of the regular stream or second year of the two-year fast track option at Memorial University School of Nursing and the 10 medical students were in the third year of their medical degree program in the Faculty of Medicine, Memorial University. Once students volunteered to take part in the study they were assigned a time for their HF-SICE. The majority of students had previous experience with the interprofessional education (IPE) modules offered at Memorial University, which involved group discussions and/or role playing (80%). While the majority of the students had some form of previous simulation experience (87%), the researcher is not aware of any interprofessional pre-licensure healthcare team simulation experiences offered at Memorial University in which the students were expected to assume their own clinical role. Therefore this was the first time these students had come together as an interprofessional group to participate in a HF-SICE.

The study sample is representative of participants in other interprofessional pre-licensure research that was found. Nine of the 10 interprofessional high-fidelity simulation studies reviewed utilized senior level students regardless of their program of study (Aliner et al., 2014; Baker et al., 2008; Dillon, Noble & Kaplan, 2009; Garbee et al., 2013; Krall et al., 2013; Luctkar et al., 2010, Reese, Jefferies & Engum, 2010; Smithburger et al., 2013; Tofil et al., 2013) and only one study used novice nursing students (Bolesta & Chmil, 2014). The authors of that study did not explain why they chose a junior cohort of students. For this particular study it was decided to use senior level students. This is in keeping with the NESF outlined by Jefferies (2007) which suggest that the simulation be challenging, within the student's skill set and the simulation objectives attainable. Therefore senior level students were used to ensure they had necessary classroom knowledge prior to participating in the HF-SICE.

Discussion of the Research Questions

The following section addresses the four research questions and the findings. The qualitative findings are also addressed in this section.

Attitudes towards interprofessional healthcare teams and attitudes towards interprofessional education. It was proposed at the outset of this pilot study that students would report a positive change in their attitudes towards interprofessional education (IPE) and interprofessional (IP) teams following their participation in a HF-SICE. Prior to participation in the simulation, students from both medicine and nursing reported fairly positive attitudes towards IPE and IP teams already with no statistically significant differences between the groups at baseline. This may be due to the fact that the majority of these students had already participated in an IPE module as part of their undergraduate curricula. Currently at Memorial University students in the undergraduate health sciences programs participate in case studies and role playing as part of an established IPE curriculum. This previous exposure may contribute to the positive attitude towards IPE and IP teams. Incorporating HF-SICEs into the undergraduate curricula would provide even more learning opportunities to support and nurture positive attitudes and IP learning. Another possible explanation for the reported positive attitudes of students may be due to the novelty of this new teaching approach as suggested by Baker et al.

(2008). The results of this study found statistically significant improvements in attitudes towards IPE ($t = -4.28$, $p = .000$) and IP teams ($t = -10.79$, $p = .000$) following participation in the HF-SICE. Both groups had equally positive improvements in their attitudes toward IPE and IP teams.

This is a potentially important finding for as Curran et al. (2007) stated negative attitudes can exist amongst students towards other healthcare disciplines which can have a negative impact on patient care and safety. From these findings it can be stated that both medicine and nursing students possessed pre-existing positive attitudes and there were statistically significant positive gains for both groups of students following their participation in HF-SICE. The findings of increased positive attitudes towards IPE and IP teams lend support for the use of HF-HPS as an interprofessional teaching tool. This would indicate that HF-SICEs in conjunction with the current more traditional IPE modules, is another viable tool for educators to utilize in promoting positive attitudes and facilitating a team approach to healthcare. Therefore students from the healthcare disciplines can use HF-SICEs to learn and practice their requisite skills together in the safe controlled environment of the HFS.

There were four studies identified that evaluated student's attitudes around the topic of IPE and IP teams and found similar results to those reported in this study. Bolesta and Chimil (2014) reported that nursing and pharmacy students had improved attitudes towards IPE following their participation in an HF-SICE. The remaining three studies (Baker et al. 2008; Dillon Noble, & Kaplan, 2009; Scherer et al., 2013) used medical and nursing students and reported that attitudes were consistently positive towards interprofessional simulation education and team collaboration. In only one of the four studies did the authors provide information on the previous IPE experiences of their study participants (Scherer et al. 2013). The participants in the

Scherer et al.(2013) study were similar to the participants in this study whereby the students had previous simulation experience but from an intraprofessional perspective only.

Interestingly Traynor et al. (2010) found that only 52% of a group of nursing students (n = 90) would embrace interprofessional HF-HPS. This study had a small sample and no information was provided on the IPE curriculum in their particular program or if there was any exposure to the other healthcare disciplines during their program of study. The authors did not explore or explain this finding however it could potentially represent the existence of negative or ambivalent attitudes towards IPE amongst pre-licensure nursing students. As previously noted Curran et al. (2007) and Hind et al. (2003) believe that negative attitudes towards interprofessional collaboration can lead to work dissatisfaction, poor communication and ultimately lead to negative patient outcomes. Therefore any opportunity to foster and promote positive changes in attitudes such as incorporating HF-SICEs into the pre-licensure curricula should be captured.

The findings from this study show that following participation in the HF-SICE, both nursing and medicine students reported positive changes in their attitudes towards IPE and IP teams. However to date, there are only a few corroborating studies to support this finding and more research is needed. This pilot study is the first of its kind to use an innovative approach to support teamwork and collaboration amongst pre-licensure health sciences students. As well, the study also demonstrated that HF-SICEs offer a viable teaching modality in which to promote positive changes in attitudes towards IPE and IP teams. Supporting and promoting positive attitudes in pre-licensure healthcare students is imperative to enhance collaboration and communication thereby improving patient outcomes and safety.

Satisfaction. This study also explored overall student satisfaction with their participation in the HF-SICE. Findings indicated participants had an overall mean score of M= 56.10 (SD = 3.59) with scores ranging from 48 – 60 out of a possible score of 60 on the satisfaction survey following their participation in a HF-SICE. In addition, there were no statistically significant differences between the nursing and medical student groups suggesting that both groups were equally satisfied. The fact that students from both disciplines reported high levels of satisfaction would indicate their eagerness to participate in additional interprofessional HF-SICEs. These high levels of satisfaction may be attributed to the fact that students embrace technology and the realism that the simulation environment offers. The interprofessional nature of this simulation was a new and unique experience for the students and may have been a factor which contributed to enhanced levels of satisfaction. These findings are consistent with other research in interprofessional simulated activities were students have reported high levels of satisfaction (Zhang, Thompson & Miller, 2011)

When asked what they really liked about the experience students reported that the HF-SICE was a “good opportunity to work with a member of the medicine faculty and learn each other’s roles in the team”, and a good way to practice skills in this safe, risk free environment.” Another student stated “I enjoyed getting to work with other professions in a controlled environment.” And another student felt the experience gave them insight into “understanding the importance of working together.” And finally another student reported that it was a “really great experienced to actually work side by side with other professions who are still students and learning too”. These student comments support the use of introducing HF-SICEs into the pre-licensure curriculum as a means to foster team collaboration and communication thereby overcoming the barriers within the silos of the current education curriculum.

Another possible reason for the high levels of satisfaction may be due to the fact that the simulation incorporated a realistic and intense scenario which may have stimulated a high degree of interest. All of the responses had mean scores greater than 4.33 out of a possible 5.00, this indicates a high degree of satisfaction with the overall experience. Interestingly, the most illuminating response was to the question, “would you recommend this learning experience to other learners.” This garnered the highest overall mean score ($M= 4.93$, $SD = 0.258$) indicating that students would recommend this experience to others, promoting a greater degree of interest for the participation in, as well as support for the incorporation of, HF-SICE in the curriculum.

These results are consistent with the findings of other studies using high-fidelity simulation both from an interprofessional and intraprofessional perspective. Reese et al. (2010) found similar high levels of satisfaction in their interprofessional study using HF-HPS with a group of pre-licensure nursing and medical students. In an intraprofessional study, Smith and Roehrs (2009) found that a group of nursing students overwhelmingly reported high levels of satisfaction with their HF-HPS experience. Pharmacy students (Branch, 2013; Fernandez et al., 2007) as well as medical students (Lo et al., 2011) have also reported high levels of satisfaction with their intraprofessional HF-HPS learning experiences.

Communication and teamwork skills (CATS) tool. The HF simulator laboratory is an environment where faculty can evaluate interprofessional teams of pre-licensure students as they provide care for simulated patients. The simulations can be videotaped and subsequently faculty members can review the simulations, observing teamwork behaviours and identifying the absence of essential behaviours. Faculty can then provide students with feedback, further instruction and additional opportunities to practice their skills, building their confidence and preparing them for the reality of today's interprofessional approach to patient care in the healthcare setting.

For this pilot study, the most appropriate tool found to evaluate teamwork behaviours of pre-licensure students was the CATS tool. This tool is a composite of all the other team assessment tools found in the recent literature (Frankel et al., 2007). It is a behavior-based tool that attempts to quantitatively assess communication and team skills of healthcare providers in a variety of settings and disciplines. The specific team behaviours are grouped into five categories: coordination, cooperation, situational awareness, communication, and crisis situation. These are further broken down into sub–categories which are behaviors that are considered core for collaborative team performance. Teams are scored in terms of the number of times the behavior occurs as well as the quality of the behaviors. There were only two studies found that utilized the CATS tool (Garbee et al. 2013; Smithburger et al., 2013).

Garbee et al. (2013) utilized the CATS tool in a one year quasi-experimental design study to evaluate the acquisition and retention of teamwork and communication skills with pre-licensure healthcare students. Students participated in two HF-SICE scenarios and the total CATS scores were compared from scenario one to scenario two. Paired t-tests showed that the mean CATS scores improved in all the subscales, but only the scores in the sub-categories of situational awareness and cooperation improved with statistical significance. There was no discussion as to why the authors felt these scores improved over the other categories, but they concluded the CATS tool was adequate to assess team behaviors. The authors did not report the inter-rater reliability for their study. The Smithburger et al. (2013) study also evaluated team performance behaviors using the CATS tool during HF-SICEs. Interprofessional teams of students took part in four HF-SICEs, assuming their clinical roles and each scenario was rated by two independent raters using the CATS tool. Results indicated that the overall CATS scores, which the authors did not report, improved statistically significantly from scenario to scenario. The authors also reported their inter-rater reliability using the intraclass correlation coefficient (ICC = .85) which indicates a high level of agreement between the two raters. Because only two published studies were found that utilized the CATS tool, further research is required to determine if the CATS tool reliably quantifies healthcare team performance. This current pilot study differs from the previous two studies in that it was a onetime only exploration of interprofessional team performance behaviors whereas the other two studies (Garbee et al., 2013; Smithburger et al., 2013) evaluated retention of interdisciplinary team behaviors over several HF-HPS and over a longer period of time.

This pilot study was preliminary in that its purpose was to evaluate whether HF-SICEs provided a valuable adjunct to the current IPE curriculum. It explored whether HF-HPS provides an environment in which interprofessional teams of pre-licensure healthcare students can come together and practice their communication and teamwork skills. The two independent raters for this study were able to determine, using the CATS tool as a guide, that the 10 interprofessional teams of students did in fact demonstrate some if not all of the behaviors considered essential for effective team performance. As expected there are some differences in agreement between the two raters in this study, but the ICC was .728 which is considered an acceptable level of agreement. As this tool requires the raters to score human behaviors complete congruence is very difficult to achieve. However, the scores of the two raters in this study were within 10 points of each other for seven of the 10 teams, and within five points for five of the teams. Because the authors of the CATS tool did not give an idealized score or a template for a perfect team score, one can only compare the teams within the study to one another. Overall the two raters were able to identify the teams that were performing better than those teams who were deficient in teamwork and communication skills. The two observers were in agreement as to which was the top performing team (team 3), as well as agreeing on the two teams who performed the poorest in demonstrating teamwork behaviours (team 4 and team 9). The findings suggest that despite it being the first time that these students had met each other and consequently the first time they had the opportunity to work collaboratively in providing patient care, the raters were able to determine that the HF-SICEs provided a legitimate environment in which students can come together and practice their teamwork and collaborations skills. This was one of the main purposes for carrying out this research project.

Qualitative Questions

In analyzing the responses from the open-ended questions students consistently reported that participating in the HF-SICEs helped them grasp a better understanding of the knowledge and the roles of different interprofessional team members. The student comments in this study are representative of comments from students in other HF-SICE research. In Baker et al. (2008) students participating in interprofessional simulations reported having a better understanding of team roles following their simulation sessions and found the experience to be very valuable from an interprofessional perspective. Luctkar et al. (2010) also reported that students felt comfortable learning with other healthcare students and found the HF-SICE sessions to be very valuable. In Smithburger et al. (2013) students reported feeling better about working with other professions and felt that participation in the HF-SICE helped to improve their confidence in communicating with other healthcare professionals following their HF-SICE. Reese, Jefferies, and Engum (2010) also reported that students enjoyed working with other professions and the collaborative aspect of the HF-SICE, as well as preferring face-to-face learning with other disciplines as compared to learning separately. Dillon, Noble, and Kaplan (2009) reported the common themes of teamwork and communication emerging from their data. This is representative of the findings of this pilot study where the theme of teamwork was repeated several times by the students. The individual comments made by the students consistently reflected the need for longer and more frequent HF-SICEs. This closely mirrors their comments that they thoroughly enjoyed the experience and reported high levels of satisfaction with the experience.

Study Limitations

The results of this study should be viewed with caution. It was a pilot study with a small sample size from only one university. This study would need to be replicated in several settings with more students to make more rigorous inferences about the generalizability of the findings. Participation in this study was voluntary, therefore it could be argued the students who volunteered for the study may have had a pre-existing propensity towards high-fidelity simulation and their attitudes may have already been positive in nature. Another possible limitation is the Hawthorne effect since the students were aware that they were being observed. However the students had to collaborate as a team and use their critical thinking skills in providing care in a novel critical clinical situation. During the scenario, students appeared to be so engrossed in the simulation experience that one could argue that they forgot that they were being observed. Therefore, the Hawthorne effect was thought to be minimal.

Another weakness of the study would be the quasi-experimental design. More weight could be given to the findings if there had been a control group. However, providing a new and innovative learning modality to a portion of a class is not the most optimum of educational practices and given the timeframe and scheduling constraints it was not feasible to repeat the HF-SICEs at the end of the study with a control group. Another option would be to carry out a crossover design study where the students switched half way through the semester thereby offering the HF-SICE opportunity to both groups. Credibility of the findings would be enhanced if the study had been conducted over a longer period of time with repeated exposures to a variety of HF-SICEs by the study participants. Again this was a pilot study with limited access to the simulator and considerable difficulty with scheduling the students in their off times.

The validity of the CATS tools used in this study has limited reported psychometrics and only two previous studies were found that used the CATS tool. However, the raters used in this study were knowledgeable clinicians with previous experience in IPE and high fidelity simulations and they felt that the CATS tool provided an effective measure of teamwork behaviors thereby establishing the face validity of the tool (Polit & Beck, 2008). The researcher also felt that the CATS tool was best suited for this study as it was developed for the purpose of interprofessional team assessment.

In this study the researcher also experienced many of the obstacles reported in other published research (Gough, Hellaby, Jones & MacKinnon, 2012). For example because this study was strictly voluntary students participated in their free time. Consequently, coordinating the student's schedules was a major stumbling block. It was very difficult to find a time when students from the two disciplines were able to come to the simulator laboratory. This was further complicated by a scarcity of available booking times with the high-fidelity simulator. These barriers could be over come if HF-SICEs were incorporated into the IPE curriculum of both nursing and medicine programs thus allaying any scheduling and time constraints.

While this was a small study without a control group, the findings of high levels of student satisfaction and the positive improvement of attitudes towards IPE and IP teams were demonstrated amongst the pre-licensure students following participation in a HF-SICE. As well there is evidence that this provides a safe environment in which students can practice their teamwork skills. It can be said that this study sets the stage for larger more robust research to evaluate and support the use of HFS in facilitating collaborative practice. This IPE teaching modality using high-fidelity simulation has the ultimate potential to benefit patient care and safety. As supported by the WHO (2010) strategies that promote collaborative practice have the potential to strengthen health systems and improve health outcomes.

Implications

Nursing and interprofessional education. The findings of this study support the integration of HF-SICEs into the curricula of pre-licensure nursing education. Educators and policy makers agree that IPE is imperative for collaborative practice and HF-SICEs provide opportunities to enhance interprofessional communication and team collaboration. Students in pre-licensure healthcare disciplines need to practice these skills prior to entering the workforce if we are to improve patient safety. Simulation provides a challenging yet 'safe' environment in which students from the health disciplines can work together in a realistic clinical scenario. In this pilot study, both medical and nursing students reported high satisfaction with the experience and endorsed more frequent HF-SICE sessions throughout their curriculum. This suggests a high level of acceptance of HF-SICEs by the students.

However, a significant barrier to implementing this education strategy in pre-licensure education may be insufficient joint coordination and planning by the different healthcare disciplines when developing their individual curricula. Nursing education can be a leader in integrating HF-SICEs into the curriculum and be instrumental in working with the other healthcare disciplines to reduce the "silo-like" education approach. Working together, the health professional schools and faculties can develop a time table that would allow all health professional students to come together for HF-SICE's. Educators in all healthcare disciplines need to realize that being educated in a team environment will help facilitate collaborative team performance. Regularly scheduled interprofessional simulation sessions would enable pre-licensure healthcare students to further hone their teamwork and collaboration skills prior to entering the workforce. This may lead to significant improvements in patient outcomes.

Nursing and interprofessional research. The pre-licensure healthcare disciplines are embracing IPE and acknowledging the benefits to patients' safety. As far as we are aware, this pilot study is unique in that it evaluated the impact of HF-SICEs on the attitudes of pre-licensure students towards IPE and IP teams as well as videotaped the scenarios and used the CATS tool to evaluate team performance. A larger study that builds on this pilot project, but also includes pharmacy students could be the next step in evaluating the impact on HF-SICEs on IPE outcomes (attitudes, collaboration and team performance), but also on more traditional outcomes such as knowledge, confidence and critical thinking. Ideally, the next research project would evaluate these outcomes over time and investigate if the IPE outcomes in particular transfer to the clinical practice setting.

There is also a need to develop and validate measurement instruments that capture the essence of HF-SICEs. For example, more work could be done to refine and validate the CATS tool for use with health sciences students.

Most IPE studies lack the rigorous design of randomized control studies with large sample sizes. Well-defined control groups are required in further research. As well further research needs to demonstrate, from a cost-benefit perspective that IPE positively affects changes in patient outcomes. Further, it must be proven that IPE is actually better than the silo approach of the current separate intraprofessional method of learning.

Nursing and interprofessional practice. This research provides support for integrating HF-SICEs into the pre-licensure healthcare curriculum as a way to promote positive attitudes towards IPE and IP teams. If nurses and other healthcare professionals enter the work force with experience as collaborative team members then there are potential benefits to patient outcomes, especially safety. Research has reported that the novice nurse often lacks confidence and experience in communicating with physicians and other members of the interprofessional team which has serious implications for patient safety (Dyess & Sherman, 2009). The Joint Commission (2008) reported that 70% of sentinel events are the result of breakdowns in communication. Therefore it is essential that pre-licensure healthcare providers have experience in communicating and collaborating with other members of the interprofessional team to ensure safe practice. These valuable experiences can be provided through HF-SICEs.

Conclusion

This study evaluated the use of HF-SICEs as an alternate teaching modality in which to teach pre-licensure health sciences students their requisite skills of teamwork and collaboration. It also evaluated if student attitudes towards IPE and IP teamwork were improved following participation in a HF-SICE. Previous IPE studies have used HF-HPS, but have not evaluated the impact on student attitudes toward IPE and IP teamwork. As with much of the previous research using HF-HPS, students in this study reported moderate to high levels of satisfaction with the experience. Their individual comments indicated that they would like to have more frequent HF-SICEs through their program of study.

Since this was a small pilot study the findings cannot be generalized to the larger population, however it does lend support to conducting larger scale student studies. It also provides preliminary evidence to support the use of HF-HPS for faculty to teach future healthcare team members their requisite teamwork skills. Interprofessional education has been sanctioned globally by the World Health Organization (2010). It has been embraced internationally by the Institute Of Medicine (2003) and nationally by the Health Council of Canada (2005). The responsibility now lies with healthcare educators to develop and implement effective IPE modules in pre-licensure curricula and modules that incorporate HF-SICEs and nurse researchers to assess the impact of those modules on teamwork and collaboration in practice.

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Appendix A

MEMORIAL UNIVERSITY

Interdisciplinary Committee on Ethics in Human Research (ICEHR)

Office of Research - IIC2010C
St. John's, NL Canada A1C 5S7
Tel: 709 864-2561 Fax: 709 864-4612
www.mun.ca/research

ICEHR Number:	**2012-200-NU**
Approval Period:	**October 19, 2011 – October 31, 2012**
Funding Source:	-
Responsible Faculty:	Dr. Sandra LeFort, School of Nursing Dr. Sandra Macdonald, School of Nursing
Title of Project:	***Assessing the impact of a high-fidelity simulated interprofessional clinical experience on attitudes, collaboration and teamwork in health sciences students: a pilot study***

October 19, 2011

Ms. Cynthia Brown
School of Nursing
Memorial University of Newfoundland

Dear Ms. Brown:

Thank you for your email correspondence of October 15, 2011 addressing the issues raised by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) concerning the above-named research project.

The ICEHR has re-examined the proposal with the clarification and revisions submitted and is satisfied that concerns raised by the Committee have been adequately addressed. In accordance with the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (TCPS2)*, the project has been granted *full ethics clearance* for one year from the date of this letter.

If you intend to make changes during the course of the project which may give rise to ethical concerns, please forward a description of these changes to Mrs. Brenda Lye at icehr@mun.ca for the Committee's consideration.

The TCPS2 requires that you submit an annual status report on your project to the ICEHR, should the research carry on beyond October 31, 2012. Also to comply with the TCPS2, please notify us upon completion on your project.

We wish you success with your research.

Yours sincerely,

M Shute

Michael Shute, Th.D.
Chair, Interdisciplinary Committee on
Ethics in Human Research

MS/bl

copy: Supervisors – Dr. Sandra LeFort, School of Nursing
Dr. Sandra Macdonald, School of Nursing

Ethic extension letter

Interdisciplinary Committee on Ethics in Human Research (ICEHR)

Dear Ms. Brown,

Thank you for your response to our request for an annual status report advising that your project will continue without any changes that would affect ethical relations with human participants.

On behalf of the Chair of ICEHR, I wish to advise that the ethics clearance for this project has been extended to October 31, 2015. The *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans* (TCPS2) requires that you submit an annual update to ICEHR on your project, should the research carry on beyond October 31, 2015. Also, to comply with the TCPS2, **please notify us upon completion of your project**.

ICEHR Ref. No.	2012-200-NU
Project Title:	(2012-200-NU) Assessing the impact of a high-fidelity simulated interprofessional clinical experience on attitudes, collaboration and teamwork of Health Science students: a pilot project
PI:	**Ms. Cynthia Brown** **School of Nursing**
Supervisor:	Dr. Sandra LeFort
Clearance expiry date:	October 31, 2015

We wish you well with the continuation of your research.

Sincerely,
Susan Mercer
Secretary, ICEHR

ORS reference only - 20120469

Appendix B

VOLUNTEERS NEEDED!!!

WHO: 3rd & 4th year Medical, & Nursing & 4th year Pharmacy Students

WHY: High- Fidelity Interprofessional Simulation Research.

HOW: Contact C. Brown: brocyn@mun.ca

Participants names will be entered into a draw for a $$ **75** gift certificate for the **KEG Restaurant**

ICEHR approval 2012-200-NU

Appendix C

MEMORIAL UNIVERSITY

Office of the Dean
School of Pharmacy

Health Sciences Centre
St. John's, NL, Canada A1B 3V6
Tel: 709 777 6571 Fax: 709 777 8301
www.mun.ca/pharmacy

September 8, 2011

To whom it may concern;

As dean of Memorial University's School of Pharmacy I am writing to inform the necessary parties that I support Cynthia Brown in her research project. I acknowledge and support her in approaching the pharmacy students to volunteer as participants in her simulated interdisciplinary clinical experience. Cynthia has informed me that she will obtain an informed consent from the pharmacy students and Memorial University's ethics committee has approved the research project.

Please feel free to contact me for further clarification.

Yours truly,

Linda R. Hensman

Linda R. Hensman, Pharm.D., MBA
Associate Professor and Dean

Appendix D

MEMORIAL UNIVERSITY

School of Nursing

300 Prince Philip Drive, St. John's, NL Canada A1B 3V6
Tel.: 709 777 6695 Fax: 709 777 7037
www.mun.ca/nursing

November 29th, 2011

Ms. Cynthia Brown
School of Nursing

Dear Ms. Brown:

At the November 4th, 2011, meeting of the Executive Committee for the School of Nursing, your research proposal was reviewed. The Committee members were very supportive of your research. Your request to survey nursing students in 3rd year or 4th year was approved. You are advised that participation for students would be voluntarily and that no academic prejudice would result if a student decided not to participate.

We wish you success with your research.

Yours sincerely,

Judith McFetridge-Durdle

Judith McFetridge-Durdle, Ph.D., R.N.
Director

JMD/estc

Appendix E

Dear Cynthia Brown,

Dr. Tanis Adey forwarded your request to me regarding your proposed research project.

Your e-mail contains insufficient information for me to act on your request.

If, your proposal involves our students' participation during class time or during a scheduled course, then I will need to meet with you to discuss this in greater detail. You can arrange a meeting by contacting our office secretary (who is copied on this e-mail).

If, however, your research proposal has nothing to do with our courses or scheduled hours then, you should likely be communicating through the Student Affairs office, and they in turn, will likely communicate with the Medical Student Society (MSS) regarding the best way to contact and schedule the students for your study.

In the event that your study has nothing to do with one of our courses or scheduled class time, please contact Dr. Paul Dancey, who is Acting Assistant Dean of Student Affairs (Paul.Dancey@easternhealth.ca).

Best wishes for success on your project.

Donald W. McKay, Ph.D.
Associate Dean of Undergraduate Medical Education
H2743D
Faculty of Medicine
Memorial University of Newfoundland
St. John's NL
Canada A1B 3V6

1–709-777-6669 phone
1-709-777-8379 fax

From: Adey, Tanis
Sent: Thursday, November 24, 2011 9:32 AM
To: Brown, Cynthia
Cc: UGME ASSOCIATEDEAN
Subject: Re: research

Hi Cynthia,
I am forwarding your email to Dr. Don McKay. Dr. McKay in now the Associate Dean of UGME and he would be the most appropriate person to discuss this with.
Best wishes,
Tanis

From: "Brown, Cynthia" <brocyn@mun.ca>
Date: Thu, 24 Nov 2011 09:24:12 -0330
To: Tanis Adey <tadey@mun.ca>
Subject: research

Dear Dr. Adey,

Dr. Darryl Boone suggested I contact you directly.I am a masters student in the faculty of nursing and I am proposing to conduct research with students in nursing, medicine and pharmacy. i will be taking these student to the high fidelity simulator,here at the medicine faculty and evaluating their interprofessional teamwork skills. Dr Boone is collaborating with me on this. I am requesting permission from you to contact the medicine student to participant in this research. I had previous had conversations with Paula Richards coordinator for UGME,who had said that this should not be a problem. I have obtained ethics approval from ICHER.

Please feel free to contact me should you have any questions.
I really appreciate your time.
Cynthia Brown

Appendix F

Cynthia Brown
School of Nursing
Memorial University of Newfoundland

Interdisciplinary Committee on
Ethics in Human Research (ICEHR)
Office of Research
St. John's, NL
A1C 5S7
Re: **ICEHR number 2012-200-NU**

Dear ICEHR chairperson:
I am writing to request ethics approval for a minor change in the process for the recruitment of participants in my research study titled "*Assessing the impact of a high-fidelity simulated interprofessional clinical experience on attitudes, collaboration and teamwork in health sciences students: a pilot study*". Although I anticipate that I will have adequate numbers of nursing and pharmacy volunteers, I have encountered difficulty in recruiting the required numbers of medical students to conduct my proposed research study. As a result I am requesting permission to offer an incentive to potential participants. Please see the attached poster which I would like to circulate in the three professional schools.
My two Master's thesis supervisors have approved this change.
I look forward to your reply.
If you require a hard copy of this request please let me know and I will drop it off to your office.
Sincerely

Cynthia Brown

cc. Dr Sandra MacDonald
Dr. Sandra LeFort

Hi Cynthia
Please add the ICEHR approval statement to the recruitment poster.
Also, if some people have already participated in the study, their names should be included /entered in the draw for the gift certificate.
Theresa

Theresa Heath, BA BEd MA
Ethics Officer
Interdisciplinary Committee on Ethics in Human Research (ICEHR)
Bruneau Centre for Research and Innovation, Room 2010 D
Memorial University of Newfoundland, St. John's, NL, A1C 5S7
Tel: (709) 864-2861

Appendix G

Consent to Take Part in Research

TITLE: Assessing the Impact of a High- Fidelity Simulated Interprofessional Clinical Experience on Attitudes, Collaboration and Teamwork in Health Sciences Students: A pilot Study.

Researcher: Cynthia Brown, Masters of Nursing student

Memorial University of Newfoundland

brocyn@mun.ca

225 Waterford Bridge Road

St. John's NL, A1E 1E4

709-738-0572

Supervisors: Dr. Sandra LeFort

Professor School of Nursing

Memorial University of Newfoundland

slefort@mun.ca Tel: 709-777-2232

&

Dr. Sandra Macdonald

Professor School of Nursing

Memorial University of Newfoundland

smacdon@mun.ca Tel: 709-777-6753

You have been invited to take part in a research study entitled "Assessing the Impact of a High-Fidelity Simulated Interprofessional Clinical Experience on Attitudes, Collaboration and Teamwork in Health Sciences Students: A pilot Study." This form is part of the process of informed consent. It should give you a basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take time to read this carefully and to understand any other information given to you by the researcher.

It is up to you to decide whether to be in the study or not. Before you decide, you need to understand what the study is for, what risks you might take and what benefits you might receive. If you choose not to take part in this research of if you decide to withdraw from the research h once it has started. There will be no negative consequences for you, now or in the future.

The researchers will:

- discuss the study with you
- answer your questions
- keep confidential any information which could identify you personally
- be available during the study to deal with problems and answer questions

Introduction/Background:

Students for the healthcare disciplines often embark their careers with little or no experience working with the other members that comprise the healthcare team. Yet, following graduation this is an expected skill, it is well documented in the literature that cohesive team performance reduces medical error and enhances patient safety.Simulation has been used as a teaching and learning strategy for many years in the military, aviation and nuclear industries to provide teamwork training in order to avoid and manage hazardous errors (Malac et al., 2007). The medical community has been using simulation since the early 1980's to provide students with opportunities to practice their requisite skills prior to performing on a real patient (Hunt, Shilkofski, Stavroudis, & Nelson, 2007). In recent years, high fidelity simulation has been introduced into the nursing curricula to teach nursing students their required skill set, and to encourage critical thinking (Reese et al., 2010). Most recently simulation is being introduced into pharmacy curricula to teach communication skills (Mesquita et al., 2009) and promote the safe and knowledgeable use of medications (Thompson &Bonnell, 2008). As these three health professions are currently using intraprofessional simulation education, albeit to different extents, the next logical step is to progress to interprofessional simulation education. Bringing the professional students together in a simulated clinical learning environment would facilitate and nurture the teamwork that is required and expected of these students upon graduation. If simulated interprofessional clinical experiences (SICEs) were integrated into the curriculum of nursing, medicine and pharmacy education programs, there is great potential to improve confidence, knowledge, critical thinking, collaboration and teamwork in the practice setting. This could ultimately lead to improved patient care and safety, which is the raison d'être for teamwork and collaboration in the health sciences professions (Robertson &Bandali, 2008). There exist a vast body of knowledge supporting clinical simulation and an equivalent quantity of research supporting interprofessional education, yet there is a scarcity of literature linking the two (Robertson &Bandali, 2008).

Purpose of study:

To assess the impact of high- fidelity simulated interprofessional clinical experiences on attitudes, collaboration and teamwork in health sciences students.

What you will do in this study:

The day of the study you will be prebriefed about the study and its objectives. You will be given the opportunity to ask questions. Following a brief orientation to the High fidelity simulator you will take part in a simulated clinical experience where you will be given report on a simulated patient admitted to hospital. You will be expected to care for this patient as if in the real clinical setting. You will care for this patient according to your skill level and knowledge. The scenario will take approximately 20 minutes and will be videotaped. Immediately following the scenario there will be a debriefing session where the video will be reviewed, feedback will be given and questions will be addressed. You will also complete the post study questionnaire.

Length of time:

This entire session will take approximately 2 hours of you time.

Possible risks and discomforts:

There will be no academic prejudice as a result of refusing to take part in this study. Agreeing to take part will require approximately two hours of your time. It is also recognized that some students may experience anxiety in taking part in the simulation experience. Every effort will be made by the researcher to alleviate any fears or anxieties that the students may feel.

Benefits: It is not known whether this study will benefit you.

Liability statement:

Signing this form gives us your consent to be in this study and to have the session videotaped. It tells us that you understand the information about the research study. When you sign this form, you do not give up your legal rights. Researchers or agencies involved in this research study still have their legal and professional responsibilities.

Confidentiality

Protecting your privacy is an important part of this study. Every effort to protect your privacy will be made. Your name will not appear on any of the research data and you will not be identified in any reports and publications.

When you sign this consent form you give us permission to

- Collect information from you
- Share information with the people conducting the study
- Videotape the simulation session.

<u>Use of records</u>

The research team will collect and use only the information they need for this research study.

This information will include your

- age
- gender
- discipline
- previous simulation experience
- videotapes of scenario

- information from questionnaires

Information collected for this study will be kept for 5 years.
If you decide to withdraw from the study, the information collected up to that time will continue to be used by the research team. It may not be removed. This information will only be used for the purposes of this study

Storage of Data:

Information collected and used by the research team will be stored by researcher, in a locked drawer in her office room 2950 MUN School of Nursing, Cynthia Brown is the person responsible for keeping it secure.

Your access to records:

You may ask the researcher to see the information that has been collected about you.

Reporting of Results:

The results will be reported in a thesis written by the researcher. Finding from the study will be submitted to scholarly journals for the purpose of publication. You will not be identified personally in any way.

Questions:

If you have any questions about this study, you can meet with the investigator who is in charge of the study at this institution.
That person is: Cynthia Brown 777-2251

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have any ethical concerns about the research (such as the way you have been treated or your rights as a participant), please contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 864-2861.

Consent:

Your signature on this form means that:

- you have read the information about the research
- you have been able to ask questions about this study
- you are satisfied with the answers to all of your questions
- you understand what the study is about and what you will be doing
- you understand that you are free to withdraw from the study at any time, without having a reason, and that so will not affect you in the future.

If you sign this consent,you do not give up your legal rights, and do not release the researchers from their professional responsibilities.
The researcher will give you a copy of this form for your records.

Your Signature:

I have read and understood the description provided; I have had an opportunity to ask questions and my questions have been answered. I consent to participate in the research project, understanding that I may withdraw at any time. A copy of this consent had been given to me for my records.

Signature of participant   Date

______________________________   ______________________

Researcher's Signature:
I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

______________________________   ______________________
Signature of investigator   Date

Telephone number: ______________________
Email address: brocyn@mun.ca

Appendix H

Participant Code:__________

Demographic Information

1 In which professional program area and year are you currently registered (please circle appropriate year)?

Undergraduate Studies

Medicine	3	4
Nursing (BN collaborative)	3	4
Nursing (BN fast-track)	1	2
Pharmacy	3	4

2. What is your year of birth (eg.1978)? __________

3. Are you; Male Female
(Please circle one)

4. Have you had any prior simulation experience Yes No
(Please circle one)?

5. Have you had any previous Interprofessional education experience Yes No
(please circle one)?

Appendix I

Participant Code______________

Attitudes Towards Interprofessional Education

We are interested in learning how you feel about the relevance on interprofessional education(i.e. shared learning activities involving students from more than one healthcare professional program) to students development as healthcare professionals.

Please indicate you level of agreement with each of the following statements, by checking the appropriate space following each statement
Use the scale SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree.

Statement:	SD	D	N	A	SA
1. Interprofessional learning will help students think positively about other healthcare professionals.					
2. Clinical problem solving can only be learned effectively when students are taught within their individual department/school.					
3. Interprofessional learning before qualifications will help health professional students to become better team-workers.					
4. Patients would ultimately benefit if healthcare students worked together to solve patient problems.					
5. Students in my professional group would benefit from working on small group projects with other healthcare students.					
6. Communication skills should be learned with integrated classes of healthcare students.					
7. Interprofessional learning will help to clarify the nature of patient problems for students.					
8. It is not necessary for undergraduate students to learn together.					
9. Learning with students in other health professional schools helps undergraduates become more efficient members of the healthcare team.					
10. Interprofessional learning among healthcare students will increase their ability to understand clinical problems.					
11. Interprofessional learning will help students to understand their own professional limitations.					
12. For small- group learning to work, students need to trust and respect each other.					
13. Interprofessional learning among health professional students will help them to communicate better with patient and other professionals.					
14. Team working skills are essential for all healthcare students to learn.					
15. Learning between heath care students before qualification would improve working relationship after qualification.					

Used with permission Curran et al., 2007.

Appendix J

Participant Code____________

Attitudes Towards Interprofessional Healthcare Teams

We are interested in learning how you feel about interprofessional healthcare teams (i.e. participation of three or more professions in collaborative patient care).

Please indicate your level of agreement with each of the following statements, by checking the appropriate space following each statement.

Use the scale SD=strongly disagree; D= Disagree; N=neutral; A= agree; SA= strongly agree.

Statement:	SD	D	N	A	SA
1. Patients receiving interprofessional care are more likely than to be treated as a whole person					
2. Developing an interprofessional patient care plan is excessively time consuming.					
3. The give and take among team members helps them make better patient care decisions.					
4. The interprofessional approach makes the delivery of care more efficient.					
5. Developing a patient care plan with other team members avoids errors in delivering care.					
6. Working in an interprofessional manner unnecessarily complicates things most of the time.					
7. Working in an interprofessional environment keeps most health professional enthusiastic and interested in their jobs.					
8. The interprofessional approach improves the quality of care to patients.					
9. In most instances, the time required for interprofessional consultations could be spent in better ways.					
10. Health professional working as teams are most responsive then others to the emotional and financial needs of the patient					
11. The interprofessional approach permits health professional to meet the needs of family caregivers as well as patients.					
12. Having to report observations to a team helps team members to better understand the work of other health professionals.					
13. Hospital patient who receive interprofessional team care are better prepared for discharge then other patients.					
14. Team meetings foster communication among team members from different professions or disciplines.					

Used with permission Curran et al. 2007

Appendix K

Study Objectives

Upon completion of the HF-SICE the students will be able to:

- Identify and discuss the role of different professionals on an interprofessional team

- Value the roles of other health professionals and the importance of an interprofessional approach to patient care.

- Develop an interprofessional plan of care for the patient

- Discuss the importance of effective communication between team members.

Clinical Scenario

Patient History

78 year old, Mr. John Smith presented to the Emergency department via ambulance with a history of fall over a flight of stairs. On arrival to the ER he was complaining of left upper quadrant adnominal pain, left leg pain and left shoulder pain/ he was noted to have bruising top the left upper quadrant of his abdomen. Vital signs BP126/74, HR 68, RR 18, T 36.0, O2 Sat 98% on room air. CT scan showed possible splenic injury. CT head negative. No fractures seen on X-ray. He had a CBC and electrolytes drawn in ER, HGB 126 all other blood work was normal. He was cross matched for 2 units packed red blood cells. He was admitted to the surgery floor by the surgery residents for overnight observation. Repeat blood work including a PTT/INR was sent at 0600hrs this am.

Mr Smith is a widower, he resides in an assisted living complex; he has a history of coronary artery disease (CAD), Non-insulin dependent diabetes (NIDDM), peripheral vascular disease (PVD), Mitral Valve replacement 5 years ago, gastroesophageal reflux disease (GERD), and gout. He is taking several medications for his medical condition.

Appendix L

Medication List:

Allopurinol 10 MG OD, Metformin 500MG BID, Diabeta 5 MG BID, Pariet 20MG OD, Metoprolol 75 MG BID, Lipitor 10MG OD, Altace 10MG OD, Immovane 7.5MG QHS PRN, Gravol 25MG PRN, Ativan 1.0 MG QHS PRN, ECASA 81MG OD, Warfarin 3MG OD, Septra DS 1 Tab BID (started 3 days ago for a UTI).

He is allergic to Penicillin

Appendix M

High-Fidelity Simulation Interprofessional Clinical Experience
Student Survey

Participant Code: _______________

Using the following scale, please rate your satisfaction with each of the following aspect of this interprofessional simulated learning experience. *Use the scale SD= strongly disagree: D= disagree: N= neutral: A=agree: SA= strongly agree: NA= not applicable*

	SD	D	N	A	SA	N/A
1.This learning experience has enhanced my understanding of the subject area						
2. This learning experience has enhanced my understanding of interprofessional teamwork in the subject area.						
3. I learned a great deal about the role of my profession on an interprofessional team in this subject area.						
4. I learned a great deal about the role and expertise of other health professionals.						
5. The learning objectives of this learning experience were clear.						
6. The workload of this learning experience was fair.						
7. The experience was well organized						
8. The following activities were useful in facilitating my learning:						
a. Prebriefing discussion						
b. Orientation to simulator						
c. Debriefing						
9. I would recommend this to other learners.						
10. Overall this was a meaningful experience.						

Modified with permission Curran et al., 2007.

Appendix N

Communication and Teamwork Skills (CATS)

Date:_________________ Team Code_________________

Category	**Behavior**	**Observed & Good**	**Variation in Quality**	**Expected but not observed**	**Comments**
Coordination	- Briefing -Verbalizing plan				
	-Verbalizes expected timeframes -Debriefing				
Situational Awareness	-Visually scans environment				
	- Verbalizes adjustments in plan as changes occur				
Cooperation	- Request external resources if needed				
	-Ask for help from team as needed				
	-Verbally request team input				
	-Cross monitoring				
	-Verbal assertion				
	-Receptive to assertion and ideas				
Communication	-Closed loop -SBAR				
	-Verbal updates think aloud				
	-Use names				
	-Communicate with patient				
	-Appropriate tone of voice				

If Crisis Situation Arises

Category	Behavior	Observed and good	Variation in quality	Expected but not observed	Comments
Coordination	Establish event manager				
Cooperation	Escalation of asserted concern				
Communication	Critical language				